In: Effects of Bomb. Japan (U.S. Strateg. Bomb. Surv.) Wash., 1947,

THE UNITED STATES

STRATEGIC BOMBING SURVEY

THE EFFECTS OF BOMBING ON HEALTH AND MEDICAL SERVICES IN JAPAN

Medical Division

Dates of Survey:

24 October—31 November 1945

Date of Publication:

June 1947

This report was written primarily for the use of the U. S. Strategic Bombing Survey in the preparation of further reports of a more comprehensive nature. Any conclusions or opinions expressed in this report must be considered as limited to the specific material covered and as subject to further interpretation in the light of further studies conducted by the Survey.

FOREWORD

The United States Strategic Bombing Survey was established by the Secretary of War on 3 November 1944, pursuant to a directive from the late President Roosevelt. Its mission was to conduct an impartial and expert study of the effects of our aerial attack on Germany, to be used in connection with air attacks on Japan and to establish a basis for evaluating the importance and potentialities of air power as an instrument of military strategy for planning the future development of the United States armed forces and for determining future economic policies with respect to the national defense. A summary report and some 200 supporting reports containing the findings of the Survey in Germany have been published.

On 15 August 1945, President Truman requested that the Survey conduct a similar study of the effects of all types of air attack in the war against Japan, submitting reports in duplicate to the Secretary of War and to the Secretary of the Navy. The officers of the Survey during its Japanese phase were:

Franklin D'Olier, *Chairman.*
Paul H. Nitze, Henry C. Alexander, *Vice Chairmen.*
Harry L. Bowman,
J. Kenneth Galbraith,
Rensis Likert,
Frank A. McNamee, Jr.,
Fred Searls, Jr.,
Monroe E. Spaght,
Dr. Lewis R. Thompson,
Theodore P. Wright, *Directors.*
Walter Wilds, Secretary.

The Survey's complement provided for 300 civilians, 350 officers, and 500 enlisted men. The military segment of the organization was drawn from the Army to the extent of 60 percent, and from the Navy to the extent of 40 percent. Both the Army and the Navy gave the Survey all possible assistance in furnishing men, supplies, transport, and information. The Survey operated from headquarters established in Tokyo early in September 1945, with subheadquarters in Nagoya, Osaka, Hiroshima, and Nagasaki, and with mobile teams operating in other parts of Japan, the islands of the Pacific, and the Asiatic mainland.

It was possible to reconstruct much of wartime Japanese military planning and execution, engagement by engagement, and campaign by campaign, and to secure reasonably accurate statistics on Japan's economy and war production, plant by plant, and industry by industry. In addition, studies were conducted on Japan's over-all strategic plans and the background of her entry into the war, the internal discussions and negotiations leading to her acceptance of unconditional surrender, the course of health and morale among the civilian population, the effectiveness of the Japanese civilian defense organization, and the effects of the atomic bombs. Separate reports will be issued covering each phase of the study.

The Survey interrogated more than 700 Japanese military, government, and industrial officials. It also recovered and translated many documents which not only have been useful to the Survey, but also will furnish data valuable for other studies. Arrangements have been made to turn over the Survey's files to the Central Intelligence Group, through which they will be available for further examination and distribution.

TABLE OF CONTENTS

I. INTRODUCTION

In this report, the Medical Division has attempted to describe the system of public health and medical care in Japan, and to analyze the direct and indirect changes therein caused by the war, particularly by bombing. The report "Effects of Bombing on Health and Medical Care in Germany" was used as a general guide, and the chapters which follow have been presented under similar headings in an endeavor to make the two reports comparable.

SURVEY STAFF

The staff of the Medical Division of USSBS consisted of six officers and one civilian from the Public Health Service, three officers and four enlisted men from the Army. The Chief of the Medical Division; Brigadier General Lewis R. Thompson, Assistant Surgeon, United States Public Health Service; could select freely the Public Health Service officers attached to the Survey, and chose officers known for their ability in certain fields of public health work. The Army and Public Health Service officers detailed to these several fields were: Major Luther L. Terry, USPHS, medical education and medical care; Lieutenant-Colonel Robert H. Flinn, USPHS, industrial hygiene, venereal diseases and tuberculosis; Major Robert S. Goodhart, USPHS, and Major Henry J. Rugo, A.U.S., food supplies and nutrition; Major Jesse Yaukey, USPHS, vital statistics; Lieutenant-Colonel Harold B. Hilton, A.U.S., medical supplies, Colonel Ralph E. Tarbett, USPHS, and Captain Paul J. Houser, A.U.S., sanitary engineering. The section on the number and nature of casualties after bombing was a joint contribution by Major Terry and Major Jaukey Mr. Lester J. Marier of the U. S. Public Health Service acted as executive secretary for the Medical Division.

SURVEY SCOPE

As in the German report, the Survey was limited to specific cities which would give a representative picture. The wisdom of this decision became apparent when we were able to obtain a first-hand view of the over-all situation after arriving in Japan. The cities selected were Tokyo, Yokohama, Osaka, Kobe, and Kyoto. The first four of these cities had been bombed, with destruction varying from 37 percent in Osaka to 56 percent in Kobe. Kyoto was selected for comparative purposes because it had not been bombed. It served as an excellent example of a Japanese city which was operating under wartime conditions without any interruption of its sanitary facilities or public health administration. In the collection of vital statistics certain other cities were added to give a somewhat broader base line.

INFORMATION SOURCES

The information was obtained from various sources. The fact that the American Army of Occupation had already firmly established itself in Japan and had set up a Public Health and Welfare Section under the able direction of Col. Crawford F. Sams made the work of the Medical Division of USSBS much less difficult. Surveys had been made and such data collected on sanitary conditions, including water supplies. Surveys of Japanese medical and food supplies had also been made. An excellent system of weekly reports of communicable diseases by city and prefectural governments had been organized. All of this information was made available to members of the Medican Division, and through the Public Health and Welfare Section they maintained liaison with responsible officials of the Ministry of Health and Social Affairs of the Japanese Government.

The chief surgeons of the Eighth and Sixth Army Headquarters contributed detailed information about their areas of occupation. The Ministry of Health and Social Affairs of the Japanese Government, particularly the faculty of the Institute of Public Health, and the Director of the Institute of Infectious Diseases who is also Dean of the Medical Faculty of the Imperial Tokyo University, were especially helpful. Local information about the prefectures and cities was obtained from health authorities, food officials, police authorities, and both public and private hospitals. Information regarding

water supplies and sewage disposal was furnished by the sanitarians in charge of these operations. In addition, numerous health officers, physicians, nurses, factory operators and drug manufacturers were questioned.

While particular forms were not used to cover all fields of public health, an outline used by the Public Health Service was the basis for the collection of uniform data relating to water supplies and sewage disposal. The health authorities of certain cities also made actual surveys to determine existing conditions about which no information otherwise would have been available. It seemed generally that public health and medical authorities, especially those in the Public Health Institute, gave every possible assistance in obtaining the necessary data. Nevertheless, it remains impossible to judge how accurate this information was and whether or not the apparently cooperative spirit was always genuine. More especially this was true in collecting statistical data where in most cases any question resulted in the formula "that the data had been burned as a result of fire damage."

JAPANESE HEALTH ORGANIZATION

It has been stated that Japan had developed a fairly modern public health organization before the war. The central government organization, the Ministry of Public Health and Social Affairs, was organized in 1938. Although this organization appears well designed to control all public health activities in the Japanese Islands, because of the autonomous prefectural governments, the central organization is not as closely knit as, for instance, that of the British Isles. The Japanese public-health organization tends more to follow the structure found in the United States with its National Public Health Service, its consulting service and widespread grant-in-aid system to the States, and the completely autonomous state public-health departments. However, the "paper" set-up in Japan differs from the United States system in that the American state departments of health usually are well organized and are capable of carrying on their responsibilities independently. The Japanese prefectural and city health organizations are not well organized and the professional qualifications of the personnel are below standard. Another fundamental difference between the structure of United States and Japanese health organizations is that while state, city, and local health departments in the United States operate as independent units in their governmental structure, in Japan they are delegated to a position of less importance under the general police authority.

The police have supervision over doctors, dentists, midwives, nurses, masseurs, druggists, prostitutes, and the insane, and the sale, commercial preparation, and consumption of food. They also have charge of the annual compulsory cleaning of private homes and public buildings, of drainage and wells, and of the maintenance of dumping grounds. During epidemics the police attempt to prevent the spread of disease by house-to-house inspection. Physicians report the notifiable diseases to the police; the police in return report to the health section of the prefectural police department, and notify the municipal health departments where such organizations exist. Reports are finally transmitted to the Ministry of Health and Social Affairs.

While it is neither pertinent nor desirable to go into any detailed discussion of the Institute of Public Health, it is impossible not to recognize the direct and indirect influence this Institute has had on the over-all development of public health work in Japan. Many of the professors were educated for their particular fields in universities of the United States and Europe. Also, until 1944, the Institute was the principal teaching organization for the training of medical officers, veterinarians, and nurses in the public health field. Only three of the staff of the Institute were lost by induction into the military forces between 1938 and 1945. The cessation of the training of medical officers and nurses in the public health field in 1944 and 1945 may be considered of only secondary importance as the annual quota of only 50 was never reached in any year previous to the war. The large majority of public health officials and public health nurses were inadequately trained. The present Institute consists of four major departments—(1) Department for Public Welfare, Research and Education; (2) Department of Population Problems (formerly Institute of Population Problems); (3) Department of Nutrition (formerly Imperial Government Insti-

tute for Nutrition Research); and (4) Department of Industrial Safety (formerly Institute of Industrial Safety). The fire which destroyed the home office of the Ministry of Health and Social Affairs resulted in the transfer of the Ministry, its equipment and personnel, to the undamaged Institute. The amalgamation of the Ministry and the Institute seriously impaired the effectiveness of both and more seriously deteriorated the research work of the Institute.

MEDICAL FACILITIES AND PERSONNEL

The chapter, Medical Facilities and Personnel, must be introduced with an understanding of the attitude of the military forces, the central government, and even of the practicing physician himself, toward the medical care provided to the civilian public.

The Japanese physician graduating from the Imperial universities and equally well-staffed medical schools was well trained. However, there were a large number of other medical schools in Japan where the standards were very low.

Despite the fact that before the war the number of physicians per 10,000 population was steadily increasing, medical care for the civilian public was not good. This in part was because small private hospitals, mainly pay hospitals, provided the major portion of the facilities for the care of serious medical and surgical cases; and the rural dweller and unskilled worker could not afford medical care of any sort.

The military demand for physicians, the actual destruction of hospitals by bombing, the dispersal of hospital staffs, and the feeble attempts of the government to provide temporary facilities or medical care served only to accentuate the poor character of the medical services furnished the civilian population.

FOOD SUPPLY AND NUTRITION

The chapter on food supplies and nutrition is concerned with one of the most complicated yet important health problems in Japan.

The Japanese approach to the control of their food supplies was not only interesting from the standpoint of the mistakes made, but also because of the more important reflection of these mistakes in the very existence of the Japanese nation.

For a nation primarily dependent upon imports of food to maintain a minimum adequate diet for its civilian population, the continual decline of these imports to almost zero during 1945 produced complete dependence upon the crops raised within the country itself.

Such government-controlled food rationing as was possible then had an adverse effect on the civilian diet. The Japanese farmer was not dependent upon the processing of his crops before they were placed upon the retail market. This was especially true regarding rice, which he could process himself and sell directly to the consumer.

Government price control and rationing therefore reduced the quantity of foods in regular channels and greatly increased black market operations. Also, as noted in the main body of the report, the Japanese Government attempted to maintain the standard quantity of the staple diet through substitutions, even though the quality and caloric value was diminished.

The result of the low caloric diet was most evident in conditions related to malnutrition but not so evident in the production of specific diet deficiency diseases. It was noteworthy that beriberi, always prevalent before the war, decreased with the low caloric diet. The extent of malnutrition, especially among the salaried urban workers was manifested by weight losses, "war edema" and fatigue, and by the decrease of milk in nursing mothers and the higher mortality rate among their babies. In addition, the deficiency in food supplies was reflected in the basic health conditions of the nation as a whole, as seen in the mounting mortality rates and in the rising fatality rates for many types of illnesses.

ENVIRONMENTAL SANITATION

As would be expected, in studying the effects of war and especially bombing on the health and sanitary conditions of any two countries, there are certain fundamental differences which must be considered if understandable comparisons are to be reached.

The bombing survey in Germany was made in the closing days of the war. In fact, it fol-

lowed on the very heels of the Allied soldiers advancing into Germany. In Japan, however, the medical survey began approximately 2 months after the war ended and the Americans occupied Japan. It is quite clear, therefore, that the immediate effects of war and bombing on general health conditions and casualties had disappeared, although the retrospective picture was clearer because of elapsed time.

The difference in the predominant type of bombing in Japan—incendiary, as compared to demolition in Germany—confuses the comparison more than appears on the surface.

German housing and factory construction may be considered permanent. Japanese urban areas and many factories were wooden in structure, of a type peculiar to that country. In residential areas houses are mainly contiguous, producing a compactness in living conditions and a density of population not usually found in the United States or in European countries.

It is apparent, therefore, that incendiary bombing of urban areas of Japan reached its maximum effectiveness. On the other hand, incendiary bombing as it directly affected health and sanitation (except casualties resulting as a direct effect of the bombing) was peculiarly ineffective. These large urban areas destroyed by fire were, in effect, sterilized. Rats and mice, lice and fleas, were destroyed along with other animals and those human beings caught in the burned area. Neither food nor rubble remained for animal or insect existence if they returned from the unburned areas ahead of the human population.

In Germany and other European countries, demolition bombing produced extremely serious effects on city water and sewage disposal systems. As an example, in Munich (The Effect of Bombing on Health and Medical Care in Germany, Medical Branch, United States Strategic Bombing Survey, Washington, D. C., October 30, 1945, p. 238) the air raids of July and August 1944 caused severe damage to gravity-feed and distribution systems. It is stated that all five of the main feed lines running into the city were broken and that the mains were severed in approximately 850 places. It was also stated in this report that the Germans were compelled to set up elaborate repair teams in all of the cities and to maintain an adequate bacteriological check on the quality of water supplies where breaks occurred.

In Japan, incendiary bombing was again peculiarly ineffective in disrupting water supplies and sewage disposal. Several major reasons for this ineffectiveness are immediately apparent.

Although in most of the bombed cities many breaks in the main water feed lines occurred, repairs seem to have been made in a reasonable time. Water-plant operations usually were not seriously interfered with although many pumping stations were put out of commission during the period of electric power failure. Also few Japanese cities, even those with a population of 100,000 and over, have sewers, and in these cities the major part of the civilian population is not dependent upon the average sewerage systems for the disposal of human excreta. As a corollary to this, the Japanese method of disposal of human excreta to farms for use as fertilizer leaves the original source of raw water supplies for any city in a much less polluted condition than in the United States or European countries where sewage, treated or untreated, is emptied directly into the rivers which afterwards become sources for drinking water supplies.

Probably the most serious danger of possible water pollution resulting from incendiary bombing was the thousands of leaking home installations in the burned areas to which the Japanese authorities gave little or no attention. This tremendous loss of water not only made it impossible to maintain the distribution of water in all residential areas, but caused low water pressures, which presented the possibility of backflow of polluted water into the mains.

As in Germany, the total effects of war, and more particularly, bombing, cannot be immediately assessed because years must elapse before the effects of undernourishment and the breakdown of sanitary environment on health, as evidenced especially by chronic diseases such as tuberculosis, become fully apparent. Again, as in Germany, there was no serious increase of communicable diseases in Japan although a few epidemics did occur. The German report suggested that the innate cleanliness of the German people, their training in personal sanitation, and the effectiveness of public health and sanitary organizations in maintaining a continuously excellent public-health program, were mainly responsible for the absence of epidemics

and the lack of increase in communicable diseases. The fact that there was no general increase in communicable diseases in Japan cannot be explained along these same lines. It is true that the Japanese people are naturally cleanly in their personal habits, but the population as a whole has no conception of the principles of personal hygiene and the Government itself took no organized measures to instruct people in these precepts.

There were serious interrruptions in the operations of health departments and sanitary organizations when fire and atomic bombing brought to a standstill the already poorly organized departments of prefectural and city governments. For example, the disposal of human excreta, garbage, and other household wastes halted for long periods of time and resulted in gross unsanitary conditions in the residential areas. Possibly the exodus of the population from these areas, the destruction of vermin, including flies and animal pests and their immediate breeding places, may have had a salutary effect.

INDUSTRIAL HEALTH AND HYGIENE

The chapter, Industrial Health and Hygiene, again brings out quite clearly the lack of interest of the armed forces and the central government in the walfare of the civilian industrial worker. Until the beginning of the war, Japan had taken forward steps in modern industrial hygiene practices. The establishment of the Industrial Hygiene Institute, the training of professional personnel and the enactment of the Factory Act had done much to protect the worker.

The abrogation of the Factory Act by the Tojo government and the military cliques led to a situation which gravely affected the health of the industrial worker. A direct measurement of fatigue other than reduced productivity and an increase in absenteeism and sickness rates is difficult to obtain, yet labor conditions in Japan were saturated with all the elements known to produce fatigue under ordinary circumstances. Extremely long hours of work, the extension of the continuous work period to 11 and 14 days, shortages of food, destruction of housing and transportation facilities, and consequent long travel time to work formed the ideal set-up for the promotion of fatigue and consequent absenteeism.

According to the data available, absenteeism had increased to between 20 and 30 percent by 1943, and rose to approximately 50 percent in private industries after the raids in 1945. In industries controlled by the military the rise was much less spectacular but nevertheless there was a definite rate increase of somewhat over 10 percent. How much of this absenteeism was caused by illness and how much by the pathological condition of fatigue is only conjectural, but its reflection on production is measurable. It has been stated in the reports of other divisions of the Survey that production decreased in 1945 in certain industries at a rate not entirely explainable either by lack of raw materials or by the destruction of factories. While absenteeism may have been important in this decrease in production, probably the most fundamental cause of all was the reduced productivity of the worker because of fatigue. The most important cause of fatigue in both the absentee and the worker on the job was lack of food.

AIR-RAID CASUALTIES

Unquestionably the greatest single factor which left its imprint on the Japanese people was the continued decrease of their food supply. On the other hand, the most direct effect of bombing on the civilian population was the severity and heavy toll of casualties. The destruction of the civilian population of any country, even if it occurs as an incident in the destruction of military objectives, is not pleasant to contemplate, especially when the majority of such casualties are women and children. The German report estimated there were approximately 500,000 fatalities from bombing during the war over a period of between 5 and 6 years. The estimated number of fatalities in Japan was approximately 333,000 in less than 1 year of bombing. It is quite evident, therefore, that whatever yardstick is used, whether fatalities per ton of bomb dropped, or fatalities per month, the number of fatalities caused by bombing in Japan was proportionally much greater than in Germany.

This chapter also shows the interesting difference in the nature of fatalities caused by predominantly incendiary bombing as compared to high-explosive bombing. Burns were

the outstanding cause of death in Japanese cities. In the first four of the five large cities studied, Tokyo, Kobe, Osaka, Sendai, and Nagoya, burns accounted for approximately 56 to 84 percent of the fatalities. In Nagoya, however, where high-explosive bombing predominated, burns accounted for only 25 percent, while deaths from direct blast were 54 percent.

The German report indicated that a careful study was made of burn and suffocation fatalities and that in incendiary raids 80 percent of such fatalities were due to carbon monoxide poisoning. No such study was made by Japanese authorities. Thus while the percentage of burn fatalities was quite high, it is impossible to break down this broad classification and determine the number of deaths caused either by carbon monoxide poisoning or suffocation prior to the actual burning of the already dead body.

It is possible only to conjecture that because of the inflammable structure of Japanese urban areas and the density of population in these areas, the number of fatalities from burns was higher than in German cities.

INFECTIOUS DISEASES

Beginning in 1942 typhoid and paratyphoid fevers showed a definite increase for Japan as a whole. This increase persisted to the end of the war although the rates in 1945 after the bombing were no higher than during 1943 and 1944. On the other hand, dysentery did show a marked increase over previous years during the late spring and summer months of 1945. In Kobe, after the June incendiary bombing, there was a sharp rise in typhoid and paratyphoid fevers that reached a peak in August and declined somewhat in September and October. The public water supply of this city and its potability is discussed in detail in the main body of the report. The possible relationship of this water supply to the epidemic could not be ignored. In Nagoya, after a serious June air raid with demolition bombs, the extreme increase of dysentery in July also reached its peak in August. This city also had a rise in typhoid and paratyphoid fevers which reached a peak in September. It is impossible to disassociate the epidemic from some factor in the enviromental sanitation which affected the entire population, and this fact again apparently points towards the public water supply. Tokyo did not show any increase in typhoid, paratyphoid or dysentary in 1945, but Yokohama did have an increase in typhoid and paratyphoid fevers. However, Kyoto, which was unbombed, had about the same increase over the same period of time.

In evaluating health conditions in Japan it is difficult not to believe that the high prevalence of dysentery, ekiri, and typhoid and paratyphoid fevers, is accounted for in great measure by the contamination of foods from the use of human excreta as fertilizer and by the prevalence of flies during the summer season. Such a conclusion is unavoidable in view of conditions similar to those found in the United States and other countries in the early part of the century, and in view of the seasonal distribution of these diseases. Also, as noted above, the war itself with its resulting movement of population groups, the necessity of foraging in the country, and the gradually increasing lack of attention to sanitary and health matters, affected the prevalence of certain communicable diseases.

The effect of the bombing of urban areas on sanitary and health conditions was not confined to the bombed area but included those areas which received the evacuees. Available data indicate that the number of persons evacuating the target areas in Honshu, Kyushu and Shikoku for other areas in these islands was approximately 27 percent of the island population exclusive of the bombed cities. The impact of added population of this magnitude in the small cities and villages must have produced overcrowding and overtaxing of medical and sanitary services.

In the chapter on tuberculosis it has been pointed out that this disease may be considered Japan's most important public health problem and is so recognized by the Japanese themselves, especially those in high authority. There still exists a conflict of opinion as to the best method or methods for controlling this disease. BCG (an attenuated or modified culture of bovine tubercle bacilli) has been used extensively in an attempt to immunize certain population groups, and the central government has reported favorably on its use. Nevertheless, a number of the more able public health officials have insisted that national control measures must be based on an active case finding pro-

gram. Such a campaign was started in industry with good results.

However, the direct effects of bombing such as the destruction of urban areas, the evacuation of people to semi-urban and rural areas with consequent exposure of otherwise uninfected groups to open and active tubercular cases among the evacuees, and the general effects of an inadequate diet will have an extremely unfavorable effect on any control measures used against this disease for a long time in the future.

MEDICAL SUPPLIES

This chapter tends to prove what might have been obvious in the beginning. Japan entered the war without adequate stocks of medical supplies, especially for the civilian population. In addition, she was largely dependent upon Germany and the United States for imports of certain new drugs, particularly those which were technologically difficult to produce. Also, Japan depended on imports of crude chemicals for the preparation of such drugs as she was able to manufacture. As in her problem of imported food supplies, the failure of any of these many factors resulted in the disruption of the entire medical supply system. This was reflected mainly in the lack of drugs for civilian usage. The quantity of drugs going into the military services remained practically constant during the war, whereas the quantity of drugs for civilian use decreased approximately 40 to 60 percent by 1945.

II. MEDICAL FACILITIES AND PERSONNEL

This section comprises insofar as possible an account of the character and availability of medical care in Japan during the years of the war with the United States. At times the general effects of the war, such as shortages of all kinds, the naval blockade, and the increasing demands for supplies and personnel, made bombing more effective than it might have been otherwise. To appraise the effects of bombing on medical care, an over-all picture is needed of prewar, wartime pre-bombing and post-bombing conditions.

So many elements enter into the constitution of good medical care that it is difficult to appraise the whole accurately, except as these parts are removed and analyzed individually. Although such a procedure is fraught with the danger that in examining an individual part, its relationship to the entire mechanism and to the end product may be forgotten, it was felt that medical care could best be appraised by studying the more important elements as they related to the whole program. Thus, the presentation has been broken down into divisions on hospitals, medical education and medical personnel. The development of a public health program in Japan, as in any other country, has been important in the advancement of the people. However, a special section is not being devoted to this problem since it could be covered in the sections mentioned above.

HOSPITALS

Hospital facilities in Japan, even prior to the war with the United States, were not as plentiful as in most of the Western world. The Japanese people, especially those in small towns and rural areas, were not accustomed to receiving hospital care for their illnesses. Unless very ill, people did not go to hospitals, and many who would have been hospital patients by United States standards never received hospital treatment in Japan. Often there was not even a physician in attendance. Few of the common people could afford hospital care, and there were few "charity" hospitals as we understand the term. Within recent years, there has been a definite trend toward the development of hospital facilities in urban centers for those who were unable to pay all or a part of the expenses involved, but this development had not reached significant proportions.

Another factor to be considered in discussing Japanese hospital facilities is the use of the term "bed capacity." The rooms in most hospitals were much like the rooms in Japanese homes, with Tatami floors, and the bed was made by spreading bedding (Futon) upon the floor. Thus the bed capacity of a given hospital might vary considerably with no change in the physical structure, since the term merely indicated potential beds as represented by adequate floor space upon which a patient could be placed. On the other hand, the larger city and university hospitals were usually fairly well equipped and used Western beds throughout. This further complicated an interpretation of the figures on bed capacity because an unknown percentage of those beds were really fixed structures. However, since the term "bed capacity" appeared to be the clearest means at hand of expressing the size of an institution it was used with the proper reservations.

A further point of divergence from the common practice in the Western world was that in Japanese hospitals family members or servants often remained in the hospital to attend the patient. Even in the larger and more modern hospitals which were equipped with beds, frequently a small roll-away type of bed for the attendants was kept under the patients' beds. This feature imposed a greater load upon the hospital insofar as space was concerned, but often relieved the hospital of a great deal of the burden of nursing care.

Food for hospital patients was handled differently in various institutions. Prior to the war the more modern hospitals furnished all necessary food for the patients. Some of the smaller hospitals and clinics did not furnish any food. The usual practice, however, was for the hospital to furnish the more common basic foods, such as rice and some type of soup. The family was expected to supplement these with any additional food needed or desired by the patient. The family attendant usually prepared this food over small charcoal braziers in a room adjacent to the patient's room or ward. As the war progressed, hospitals relied more and more upon families to furnish food for the patients,

and some hospitals required that the family furnish all food.

Most of the many private hospitals in Japan were small (10 to 50 beds). Table 1 shows that all of the private hospitals averaged only 29 beds each. These small hospitals were often referred to as clinics by the Japanese, particularly when a few hospital beds were maintained in connection with a physician's office. Such hospitals or clinics have been excluded from all figures in this report if they had less than 10 beds. The larger and the better hospitals usually were controlled by some phase of the Government. Usually those entirely or partly controlled by the Imperial Government were referred to as government hospitals, and those under the supervision of the prefectural or city governments were called public hospitals. There were both public and private charity hospitals, primarily intended for free patients, but roughly 20 percent of their occupants paid fees. In addition there were private and government controlled specialized hospitals for mental diseases, tuberculosis, leprosy, communicable disease and prostitutes. These were usually listed separately when data relative to them were compiled. The last prewar year for which there was complete information relative to the number of hospitals and number of beds is 1938, and the data are shown in Tables 1 and 2. A discrepancy in these tables between the total number of hospitals and beds was due to the omission of isolation wards and hospitals which were open only when statutory communicable diseases occurred. Some communicable disease hospitals apparently were also omitted.

The number of hospital beds per 1,000 population in Japan before and after the war can be compared with similar figures for the United States (Table 3).

TABLE 1.—*Number of hospitals in Japan—1938*

Type of hospital	Number	Beds	Patients admitted during 1938
Public hospitals	127	10, 954	130, 264
Private hospitals	2, 981	87, 595	715, 572
Charity hospitals	55	4, 141	32, 865
Mental disease hospitals	158	21, 883	23, 467
Tuberculosis sanitoria	153	14, 138	24, 044
Leprosaria	17	8, 108	2, 502
Hospitals for prostitutes	115	4, 999	68, 057
Communicable disease hospitals	1, 008	24, 160	No figures given.
Sub-total	4, 614	175, 978	
Isolation wards and houses	7, 036	70, 160	No figures given.
Total	11, 650	246, 138	

TABLE 2.—*Hospitals in Japan—1938*

Type of hospital	Number	Beds	Assigned physicians
Government hospitals	38	15, 669	4, 322
Public hospitals	683	48, 297	2, 601
Private hospitals	3, 190	115, 401	9, 859
Total	3, 911	179, 367	16, 782

TABLE 3.—*Comparative number of civilian hospital beds in Japan and United States*

	Civilian population	Total civilian hospital beds	Hospital beds per 1000 population
Japan 1938	72, 222, 700	246, 138	3. 4
Japan 1945	73, 064, 000	283, 188	3. 9
United States 1943	[1] 127, 307, 884	[2] 1, 243, 184	9. 77
Mississippi (lowest)	1, 996, 333	9, 932	4. 98
New York (highest)	12, 442, 784	190, 863	15. 34

[1] Estimated civilian population, Nov. 1, 1943, based on registration for War Ration Book Four—Special Reports, Bureau of Census.
[2] Total hospital beds excluding Army and Navy hospitals and non-institutional beds in U. S. Public Health Service hospitals.

General Effects of the War

Certain effects, such as the destruction of buildings, etc., are attributable directly to bombing. However, there were an even greater number of factors to be considered which may have borne some indirect relationship to bombing but were also related to situations which were an outcome of wartime conditions. It has been quite impossible in many cases to tell which of these etiological factors was most important, as can be seen in the subsequent discussions.

The Japanese themselves destroyed many hospital facilities as a precaution against incendiary bombing. A few of the small hospitals and clinics of inflammable structure fell within areas which were being cleared as protective fire lanes (firebreaks). The firebreaks were usually designed so that they would not include larger medical facilities, most of which were of fairly fire-resistant construction. The Japanese also destroyed a considerable number of hospital beds when inflammable portions of hospitals were sacrificed to protect the remaining less inflammable buildings. An example of this was at the Imperial University Hospital in Tokyo where nearly half of the bed capacity was lost when all inflammable buildings were torn down. While the exact number could not be determined, the combined loss from these factors certainly amounted to thousands of hospital beds and in effect was just as serious as bombing destruction except that no patients were lost and all of the supplies, equipment and furnishings were saved.

Another serious effect upon the operating efficiency of Japanese hospitals was the shortage of personnel, especially physicians. Generally speaking, the Japanese armed forces depended almost entirely upon a nucleus of older regular service officers plus a very large number of younger physicians. As most of the large modern hospitals had utilized a system similar to large American hospitals whereby young physicians in training carried out a great deal of the routine duties, the removal of these men from the hospital staffs was sorely felt. Even though a large number of small hospitals and clinics were less dependent upon the younger physicians and consequently were not as seriously affected by this factor, the more important institutions had to curtail operations. The hospitals of Japan were not affected as seriously as the hospital system of the United States would have been under similar circumstances, but the effects were of significant proportions.

In addition to the shortage of physicians there was a shortage of other technical personnel. Nurses were poorly trained and inadequate in numbers. Medical technicians were almost completely absent except for the older group. However, common laborers employed in hospitals seemed to be fairly adequate in number.

The loss of personnel due to evacuation of the cities also seriously affected the hospitals. The precautionary destruction of homes in the creation of firebreaks rendered many doctors and nurses homeless, and they left their positions to move to the country. However, the personnel loss due to bombing of homes and offices and to fleeing the cities because of fear of bombing was far more significant. For instance, the director of St. Luke's Hospital, Tokyo, stated that the latter was the most serious effect that the war had upon that hospital. Because of the fear of bombing, 100 of 150 nurses and 15 of the remaining 30 physicians (the military services had already taken 30 of the original 60 physicians) fled the city. It was notable that of all the professional personnel, the most dependable to remain on the job and to perform their work properly were the student nurses. It was said that "they were more devoted to the ideals of Florence Nightingale and stuck to the job almost to an individual."

The evacuation of valuable equipment, with the removal of much X-ray equipment and other instruments ordinarily considered essential to the operation of a hospital, certainly affected the quality and probably the volume of work of these institutions.

Other conditions which affected the operation of hospitals were shortages of equipment and supplies, disturbances of hospital routine due to preparations for or fear of air raids, and loss of time consumed in foraging for food. The conditions relative to medical supplies and equipment are discussed elsewhere in this report and suffice it to say at this point that the shortages were extreme in many instances. Earlier in the war a few hospitals were able to lay in sufficient stocks to be supplied much longer than others, but for the last year of the war practically every civilian institution faced dire shortages. At the same time, military hospitals and depots often had supplies sufficient for six months or more stored in the same city. Air-raid precautions were time consuming for the personnel and often quite expensive to the hospitals, though nothing like the preparations in civilian hospitals in the European theater. Loss of efficiency due to fear of bombing was a factor of some importance but was one of those intangibles difficult to appraise accurately. In many instances the shortage of food became so severe that it was necessary for hospitals to feed their employees in order to keep them. When this could be done it was fairly successful, but when this was not possible the time lost foraging for food appeared to have been considerable.

Direct Effects of Bombing

The principal direct effect of bombing was actual destruction of hospitals. Exclusive of the atomic bombings, 969 hospitals were completely destroyed and 50 were partially destroyed, with a loss of 51,935 hospital beds. Table 4 shows the damaged and destroyed hospitals and bed capacity by prefectures as reported by the Ministry of Health and Social Affairs. If demolition bombs had been predominant, a far larger percentage of partly destroyed institutions could have been expected (Figure 1). However, high-explosive bombs played an almost insignificant role in this picture. Only a few hospitals located near strategic industrial

TABLE 4.—*Number of hospitals and hospital beds in Japan destroyed by bombing* [1]

Prefecture	Town or village	Number of hospitals destroyed			Number of beds
		Totally	Partially	Total	
Hokkaido	Nemuro City	2		2	127
Aomori	Aomori City	4		4	320
Iwate	Kamaishi City	5		5	225
Miyagi	Sendai City	9		9	650
Akita		None	None		
Yamagata		None	None		
Fukushima	Taira City	2		2	130
Ibaraki	Mito City	19	1	20	910
"	Hitachi City	1	1	2	30
Tochigi	Utsunomiya	11		11	700
Gumma	Mebashi City	6	1	7	315
"	Maoka Town	1		1	70
Gaitama	Kumagaya	2	1	3	110
Chiba	Chiba City	20		20	770
"	Tyochi City	9		9	360
"	Funabashi	1		1	50
"	Ichikawa	1		1	60
Tokyo	Tokyo City	233	19	252	16,380
"	Hachiogi City	4		4	260
"	Kitatama	1			65
Kanagawa	Yokohama	36		36	1,078
"	Kawasaki	13		13	666
"	Hiratsuka	3		3	116
Niigata	Nagaoka	7		7	245
Toyama	Toyama	19		19	832
Ishikawa		None	None		
Fukui	Fukui	13		13	780
"	Turuga	1		1	70
Yamanashi	Kofu City	7		7	292
Nahano		None	None		
Gifu	Gifu	8		8	394
"	Ogaki	8		8	160
Shizuoka	Hamamatsu	13	2	15	310
"	Shizuoka	12		12	511
"	Namazu	11		11	468
"	Shimizu	1	1	2	35
"	Koyama		1	1	25
Aichi	Nagoya	48		48	2,160
"	Toyohashi	7	1	8	360
"	Okazaki	4	2	6	270
"	Ichinomiya	3	1	4	180
Mie	Kuwana	2		2	90
"	Yokkaichi	2		2	90
"	Tsu	6		6	270
Shiga		None	None		
Osaka	Osaka	62	1	63	4,195
"	Toyonaka	4	1	5	290
"	Sakai	2	1	2	130
Hyogo	Kobe	59	1	60	3,000
"	Himeji	15		15	750
"	Amagasaki	6	1	7	350
"	Nishinomiya	5	1	6	300
Nara		None	None		
Wakayama	Wakayama	14		14	658
Tottori		None	None		
Shimane		None	None		
Okayama	Okayama	23	1	24	1,200
Hiroshima	Hiroshima	30	3	33	264
"	Kure	5	1	6	480
Yamaguchi	Shimonoseki	9		9	234
"	Ube	5		5	181
Tokushima	Tokushima	16		16	654
Kagawa	Takamatsu	20	1	21	592
Ehime	Matsuyama	14		14	445
"	Imabaru	10		10	293
"	Uwagima	4		4	102
Kochi	Kochi	27		27	657
Fukuoka	Moji	1		1	50
"	Yahata	11		11	550
"	Omuta	9	2	11	550
"	Kurume	10	1	11	550
"	Fukuoka	20	1	21	1,050
Nagasaki	Nagasaki	4	5	9	720
"	Sasebo	2	3	5	300
Kumamoto	Kumamoto	15	2	17	1,244
"	Arao	1		1	105
Oita	Oita	10	1	11	680
Miyazaki	Miyazaki	4		4	240
"	Miyakonojo	1		1	50
"	Nobeoka	1		1	60
Kagoshima	Kagoshima	19		19	848
"	Sendai	4		4	79
"	Makurazaki	4		4	81
"	Yayato	1		1	34
"	Kaseda	1		1	19
Total		1,003	58	1,060	52,991

[1] Report from Ministry of Health and Social Affairs, October 1945.

targets suffered from demolition bombs. Though a few high-explosive bombs were dropped in nearly every incendiary raid, most of the hospitals were lost during the mass burning of cities by fire bombs.

When hospitals of inflammable construction were hit by several incendiary bombs they usually burned completely. Apparently it would not have been difficult to extinguish many of the blazes if the normal fire-fighting facilities of the city had been able to concentrate on a single fire or a small number of fires. But in these incendiary raids thousands of bombs were dropped at approximately the same time and the entire surrounding areas were in flames. The fire departments were frequently destroyed or were completely ineffectual because of the magnitude of the task. Small water reservoirs near homes and buildings were inadequate and could be utilized only by "bucket brigades." The cities were so inflammable that fire-fighting equipment and personnel which were rushed into the burning areas frequently were lost in the flames. The Japanese learned that staying to fight a holocaust frequently resulted in the loss of their lives. Consequently, the usual practice was to flee the area or the city once these fire raids became established, with little or no attempt made to check the fires.

Exceptions were hospitals which had favorable locations such as the Tokyo Imperial University Hospital. There were large open areas about the buildings which nullified the danger from spreading flames. As a precautionary measure the inflammable buildings on the grounds had been destroyed, and though the entire surrounding area was completely burned the hospital suffered no damage. However, most hospitals were not so fortunately located and though not struck by incendiary bombs they were often destroyed by fires spreading from the adjacent buildings. Even buildings thought to be fireproof were completely gutted from the intense heat of the surrounding burning buildings.

The method of handling patients in the hospitals during fire raids varied. In most instances an attempt was made to rescue patients if the hospital caught fire, but in other instances the panic was so great that personnel fled with little thought of the safety of patients or any-

FIGURE 1. Destruction of one building of the Japan University Auxiliary Hospital, Hongo Ku, Tokyo, as a result of a direct hit by a high-explosive bomb.

one else. The Japanese disregard for human life was often astonishingly apparent.

The lack of any significant air-raid protection in Japanese hospitals was particularly notable when compared with the elaborate plans carried out in the European theater. The Germans constructed complex and formidable air-raid shelters and bunkers to protect patients during raids, and evacuated many patients to specially constructed hospitals in the rural areas. (Details of these plans can be obtained by consulting the report of the Medical Division of USSBS in Germany.) Although the Japanese blacked-out hospitals during raids, moved patients to inside corridors, basements or other comparatively safer portions of the buildings, and set up special operating and treatment rooms to take care of casualties, the air-raid shelters were usually pathetic in type and number. The Imperial government established a set of recommendations relative to precautions, shelters, etc., and agreed to pay half of the expenses involved. The hospital authorities at first did not believe they would be bombed and were skeptical about getting such financial assistance, so that very few of them followed the government's directions. As practically no steel or cement was available for the construction of shelters, the final outcome was that few shelters were constructed; the ones built were ineffective; and in most instances getting reimbursement for even a part of such expenditures was difficult.

Since there was little protection afforded, people were reticent about entering hospitals and many patients able to travel sought refuge in the country. The number of hospital patients decreased, but many needing treatment suffered from lack of care. Such conditions caused a deterioration of morale as well as a decline in the population's effectiveness due to illness. Under the circumstances, it was surprising that more serious outbreaks of communicable diseases did not occur.

The actual number of hospital patients killed in air raids could not be determined. In most instances, records were destroyed along with the hospitals. By interrogation of individuals one could learn of a few patients killed here and there, but in general, the Japanese seemed reluctant to admit the number lost. Even where piece-meal information could be gathered, there was not adequate time to gather enough data to reach any definite conclusions. However, it is safe to say that thousands of patients lost their lives when hospitals were destroyed and that the proportion of deaths probably was much larger than among the general population of destroyed areas.

The loss of irreplaceable equipment and supplies in ruined hospitals was an especially serious problem. Since many of the hospitals destroyed were small units located in Japanese type buildings, they could have been restored to their prebombing status without too much disturbance of service if the equipment could have been saved. There were severe shortages of medical supplies even prior to bombing, and the loss of such supplies in bombing aggravated the problem. For several months before the end of the war civilian hospitals were almost without even the basic articles. Many psychopathic hospitals were without adequate sedatives. Insulin, digitalis, sulphonamides and other basic drugs were so scarce that large general hospitals were often completely without or had only negligible quantities.

Hospital administrations repeatedly complained of the effects of bombing on hospital personnel. Often after air raids they had to work continuously for 24 to 48 hours. In short, a greatly reduced hospital staff carried as increased burden and at the same time got insufficient rest and had difficulty in getting to and from work. In time the effects became more and more evident. Morale was low. There was little with which to work. Hospitals deteriorated and in many instances would have closed had the pressure of wartime conditions not been so great. Actually, few hospitals did close, but many could have closed rather than continue as they were. The hospitals were probably in worse condition, both physically and functionally, than they had been since the beginning of this century.

Post-War Status

The Medical Division of USSBS entered Japan about two months after the cessation of hostilities. After the war ended the people had been so stunned and were so uncertain as to what to expect of their conquerors that practically no constructive or restorative work was

TABLE 5.—*Hospitals, bed capacity, occupancy and out-patients by prefectures, 15 September 1945*

Prefecture	Total hospitals	Bed capacity	Occupied beds	Number of patients (out-patient department)
Hokkaido	284	14,520	10,315	28,650
Aomori	17	2,388	1,526	2,395
Iwate	46	3,479	1,785	5,390
Miyagi	52	5,760	3,476	4,395
Akita	33	2,691	4,231	5,219
Yamagata	25	2,009	1,462	2,581
Fukushima	55	3,723	1,660	8,825
Ibaraki	40	3,293	1,120	765
Tochigi	39	2,571	667	3,574
Gumma	53	3,894	2,773	3,566
Saitama	63	3,081	1,626	1,597
Chiba	109	5,553	3,571	4,993
Tokyo	277	32,845	12,709	16,692
Kanagawa	67	6,303	207	3,976
Niigata	58	4,275	1,834	7,590
Toyama	36	2,676	900	2,648
Ishikawa	55	4,011	1,258	7,292
Fukui	20	1,727	605	2,020
Yamanashi	16	703	507	1,257
Nagano	66	4,587	1,958	5,834
Gifu	36	2,631	957	2,530
Shizuoka	61	3,034	1,335	4,265
Aichi	90	7,274	2,383	5,977
Mie	45	3,010	1,288	3,801
Shiga	33	1,938	667	2,981
Kyoto	116			
Osaka	131	19,806	5,327	10,615
Hyogo	24	1,177	559	2,692
Wakayama	19	1,222	367	1,419
Iottori	14	1,237	775	2,372
Shimane	20	1,300		
Okayama	49	5,435	4,351	3,460
Hiroshima	52	3,701	1,224	2,645
Yamaguchi	46	3,041	2,102	3,767
Tokushima	18	1,116	4,140	26,550
Kagawa	29	1,614	1,231	2,237
Ehime	50	1,932	1,069	3,599
Kochi	27	1,231	773	1,668
Fukouka	258	10,712	4,186	21,148
Saga	4	1,176		
Nagasaki	55	3,664	1,190	6,170
Kumamoto	37	1,980	482	1,959
Oita	33	1,510	389	1,177
Miyazaki	21	574	384	1,387
Kagoshima	30	2,890	1,320	
Total	2,709	193,294	90,689	231,678
Tuberculosis and leprosaria	334	79,630	35,799	
Grand total	3,043	272,924	126,488	231,678

TABLE 6.—*Number of Japanese persons requiring medical care or hospitalization, October 1945* [1]

Name of prefecture	Number of patients		
	In-patients	Out-patients	Patients at home
Hokkaido	17,000	64,000	81,000
Aomori	6,300	23,700	30,000
Iwate	4,400	16,600	21,000
Miyagi	9,500	35,500	45,000
Akita	4,800	14,200	19,000
Yamagata	9,200	34,800	44,000
Fukushima	9,000	34,000	43,000
Ibaraki	8,000	30,000	38,000
Tochigi	5,300	19,700	25,000
Gumma	6,100	22,900	29,000
Saitama	8,600	32,400	41,000
Chiba	5,900	22,100	28,000
Tokyo	18,300	68,700	87,000
Kanagawa	13,200	49,800	63,000
Niigata	8,800	33,200	42,000
Toyama	7,400	27,600	35,000
Ishikawa	6,900	26,100	33,000
Fukui	3,600	13,400	17,000
Yamanashi	1,000	4,000	5,000
Nagano	5,000	19,000	24,000
Gifu	6,700	25,300	32,000
Shizuoka	8,400	31,600	40,000
Aichi	10,900	41,100	52,000
Mie	6,700	25,300	32,000
Shiga	3,600	13,400	17,000
Kyoto	20,800	78,200	99,000
Osaka	25,200	94,800	120,000
Hyogo	17,000	64,000	81,000
Nara	3,200	11,800	15,000
Wakayama	7,400	27,600	35,000
Tottori	2,500	9,500	12,000
Shimane	3,800	14,200	18,000
Okayama	11,600	43,400	55,000
Hiroshima	9,900	37,100	47,000
Yamaguchi	7,800	29,200	37,000
Tokushima	4,800	18,200	23,000
Kagawa	13,700	51,300	65,000
Ehime	9,700	36,300	46,000
Kochi	2,700	10,300	13,000
Fukuoka	17,000	64,000	81,000
Saga	4,600	17,400	22,000
Nagasaki	8,200	30,800	39,000
Kumamoto	6,500	24,500	31,000
Oita	9,000	34,000	43,000
Miyazaki	5,000	19,000	24,000
Kagoshima	10,500	39,500	50,000
Total	395,500	1,483,500	1,879,000

[1] Estimated by Ministry of Health and Social Affairs.

done. The Medical Division therefore saw a fairly accurate picture of conditions as they had been at the time of the surrender.

One of the few evidences of an attempt to restore medical facilities was the return of supplies and equipment which had been hidden in the rural areas, but even 3 months after the conclusion of the war this movement had not reached large proportions. Difficulty of transportation, apathy and inactivity of the people, were deterrent factors. Since many buildings formerly housing this equipment had been destroyed by bombing, there was the problem of finding suitable structures or constructing new buildings in which to reestablish the hospital facilities. In a few instances where the needs were of an emergency nature, the central government requisitioned buildings and assisted in the reestablishment of hospitals. However, most of the initiative was left to the local city or prefectural authorities and little had been done.

One of the surprising facts encountered in Japan during the immediate post-war period was the low occupancy of the remaining hospitals. On 15 September 1945, only 126,488 of a total of 231,678 beds were occupied. Table 5 shows the distribution of these hospitals by prefectures and includes the number of in-patients and out-patients at that time. Though the reports were not complete at that time it was evident that only about 50 percent of the available hospital beds were occupied. Comparative hospital bed occupancy figures for the United States for 1942 were 61.4 percent and

75.1 percent for 1944. Since these figures were such a complete contradiction to the reported health conditions of the Japanese, the Public Health and Welfare Section of SCAP asked the Japanese government to compile and submit a list of the number of Japanese persons requiring medical care or hospitalization. The report was submitted on 21 October 1945 and is shown in Table 6. It was estimated that 395,500 persons were in need of hospital care and 1,483,500 needed out-patient care. When these figures were compared with the numbers actually receiving treatment, a tremendous inconsistency was noted. In other words, though there was a large number of vacant hospital beds only one of three needing hospital care and one of six needing out-patient treatment were actually receiving it. There are several contributing factors which may help to explain this inconsistency. Whereas the number of patients receiving treatment was an actual count, the number needing care was an estimation, and it was suspected that in their desire for sympathy the Japanese may well have overestimated the latter figure to a considerable degree. Also, most of the hospitals are located in large cities, and the population was still widely scattered over the rural areas. Few of the larger cities had been reoccupied by more than 50 percent. Consequently, many of the persons needing care were not in locations where they could receive it. Too, the Japanese have always been very mercenary in their distribution of medical care, with few patients admitted to hospitals unless they were able to pay. With the economic upheaval of the time, a very large percentage of the Japanese were actual paupers. The government financed medical care for those injured in air raids but free care for other illnesses and injuries generally was not provided. Thus, many who needed it were probably unable to obtain medical and hospital care because they could not pay for it.

In an attempt to determine whether these conditions would be sustained over a long period the Public Health and Welfare Section of SCAP requested the Japanese government to submit weekly reports on the numbers of hospitals, in-patients and out-patients by prefectures. These reports from 12 October to 9 November 1945, are shown in Appendices A–1, A–2, and A–3. Though the figures were not complete for all prefectures there was sufficient information to indicate the trend over this five-week period. A composite study of 23 prefectures for which the reports were complete is shown in Table 7. Over the five-week period there was a gradual decrease in the number of in-patients. While there was more fluctuation from week to week, there was a slight decrease in the number of out-patients over this period. Study of the individual prefectures reveals that most of them remained essentially unchanged, several showed slight decreases in the patient load, while Tokyo alone showed a significant sustained increase in both in-patients and out-patients.

These figures indicate that the hospital facilities for the period studied were not overburdened nor even filled to a degree consistent with most economical operation. Many people who needed care were not receiving it, but further study of the entire Japanese health situation would be necessary before one could reach more definite conclusions.

TABLE 7.—*In-patient and out-patient load of Japanese hospitals as reported by 23 prefectures (complete) from 12 Oct. to 9 Nov. 1945*

1,398 Hospitals			1,331 Hospitals		
Date	In-patient average	Total	Date	Out-patient average	Total
Oct. 12	1,861	42,797	Oct. 12	5,675	130,537
Oct. 19	1,772	40,758	Oct. 19	6,326	145,499
Oct. 26	1,703	39,169	Oct. 26	5,367	123,452
Nov. 2	1,666	38,313	Nov. 2	5,969	137,305
Nov. 9	1,670	38,407	Nov. 9	5,611	129,048

Until October 1945 the hospital bed-population ratio in Japan did not decrease from that of 1938. The Japanese had been able to replace the loss of hospitals by some type of facility, with the result of an actual increase over this period. Some of the replacement was due to the utilization of schools and other public buildings, and the conversion of military hospitals to civilian status. Generally, none of the increase was due to construction of civilian hospitals. Table 3 indicates the comparative figures for Japan in 1938 and 1945, and also a comparison with similar dates on the United States and with the two States representing the extremes in this country. It may be noted from this table

that the over-all hospital bed-population ratio in Japan was 3.9 beds per 1,000 population for 1945 while the State with the lowest ratio in the United States was Mississippi with 4.98. New York State had the highest ratio with 15.34, and the over-all figure for the United States was 9.77. Thus the comparative number of hospital beds in Japan at the time of the survey was far less than half those in the United States. A considerable proportion of the Japanese hospitals were of temporary and emergency nature and will have to be replaced or abandoned within the next few months or years.

The number of proposed and established health centers by prefectures for Japan in 1945 is shown in Appendix A–4. It portrays an official interpretation of clinical facilities available to the public but actually is a poor index. Most of these centers were not in effective operation and all were poorly staffed. The same may be said to be true with regard to the official government report on materal and child welfare work (Appendix A–5).

The situation with regard to hospital facilities in Japan was not hopeless or even critical at this time. Only half of the available beds were being utilized, but that was certainly no indication of the needs of the Japanese people. It was in part a reflection of the continuing unsettled state in Japan. To a great extent, the economic recovery of the Japanese nation would influence future developments in hospitals. Only with a better balanced economy could Japan construct and operate the hospitals that will be needed within the next few years.

MEDICAL EDUCATION

During the war with the United States, medical education in Japan deteriorated so seriously that it was threatened with suspension. The cumulative effects of individually insignficant events reached serious proportions as time progressed. An attempt is made here to point out these factors and to show the end effects. A brief explanation of prewar conditions in Japanese medical education is therefore necessary.

Prewar Status

The Japanese system of education is somewhat similar to the American schools but more closely parallels the German system. A child enters school at about 6 years of age and attends primary school for 6 years. This is followed by 5 years in middle school, at the end of which time the student is about 17 years of age. If he is working toward a medical education he may then enter high school or enter a medical college directly. Prior to the war a student was required to spend 3 years in high school before he was eligible for admission to one of the medical universities.

About the time of the china incident a compulsory military training program was instituted in Japan. The age limit was rigid and a few students were taken into the military as ordinary soldiers before completing their education, but after they had completed their service some were able to resume their medical studies. Many graduated from medical schools young enough so that they were able to obtain some hospital training before being called into military service. These draft regulations were continued up until the outbreak of war with the United States.

Medical schools in Japan fall into two groups. The higher class medical schools are spoken of as medical universities and have considerable prestige. The most prominent of the universities prior to the war were the nine Imperial Universities—seven in Japan proper, one in Formosa, and one in Korea. There were 10 other medical schools of university rank. Seven of those were established by prefectures with the support of the central government and ranked next to the medical faculties of the Imperial Universities. There were three private medical schools of university rank in Japan proper, all in Tokyo. The medical school of Keio Gijuku University had the highest reputation among the private schools and compared favorably with many governmental schools. Reference to War Technical Bulletin, TB MED 160 shows the information which was available regarding the schools of university rank before the onset of war. A list of the schools of university rank in 1945 is shown in Appendix A–6.

In addition to the universities, there were a number of private medical schools of lower rank, commonly referred to as medical colleges or medical professional schools. A few of these schools had fairly good standards but their graduates had considerably less prestige than

the graduates of schools of university rank. Whereas the graduates of the latter were automatically admitted to medical practice, the government required the graduates of the lower institutions to pass the required examinations. The medical professional schools took students directly from middle school without any high school education. They were then given medical courses varying between four and five years, including a premedical course which was not included in the regular four year course of the schools of university rank.

Women were not admitted as students to the medical schools of university rank, but in a few exceptional cases they were admitted as graduate students to certain of the prefectural and Imperial Universities. In 1941 there were three medical schools for women in Japan, two in Tokyo and one in Osaka.

In addition to the civilian medical schools, there were the Army Medical School and the Navy Medical School, both located in Tokyo. Those schools did not attain any importance until about 1939 and 1940 when the requirements for military medical personnel became prominent. All doctors taken into the military forces were given courses of 8 to 10 months in one of these schools. The program consisted of an indoctrination into military procedures and courses in diseases of particular importance to the armed forces.

In 1938 and 1939 most government medical schools instituted an "emergency medical course" which was intended to graduate more physicians in order to supply the demands of the armed forces. Actually, it simply increased the enrollment beyond the "fixed number" of students and resulted in the graduation of two classes in 1941, one in March and one in December. There were 6,253 students graduated that year in comparison to a previous high of 2,968 in 1939 (Table 8).

The medical schools of Japan were on a partial wartime basis as early as 1938. Because of demands of the undeclared war in China and in anticipation of the coming conflict, the government began to delete certain courses from the curriculum and introduce military subjects, increase the enrollment, allow an increase in the number of schools, and take other steps to train more physicians in a shorter period of time. The gradual transition over several years in Japan was not comparable to the abrupt changes that occurred in the United States in a few months.

TABLE 8.—*Number of medical schools and physicians graduated in Japan, 1938–45* [1]

Years	Number of schools	University graduates	Medical college graduates		Total graduates
			Female	Male	
1938	26	1,681	364	839	2,884
1939	39	1,690	369	909	2,968
1940	39	1,685	379	827	2,891
1941	39	3,336	760	2,157	[2] 6,253
1942	40	1,703	470	1,995	4,168
1943	44	1,626	492	1,925	4,043
1944	61	1,577	561	2,092	4,230
1945	69	1,650		2,546	4,196

[1] The number of graduates of 1941–44 includes those of medical schools in Formosa and Korea.
[2] 2 classes were graduated in 1941, March and December.

Great difficulty was encountered in appraising Japanese prewar education. Often a system that seemed well organized when viewed on paper appeared entirely different when scrutinized at the functional level. This was true of Japanese medical schools. The Japanese were able to set up a good system of teaching for the medical schools but they were unable to make it work. The fact that they were either unable or unwilling to recognize these deficiencies often resulted in confusion among themselves and others who attempted to appraise the system.

Generally speaking, the medical schools of university rank were the only ones with even partially acceptable features. Many of their professors received a part or all of their medical training abroad and were fairly sincere and competent scientists. The large majority were German-trained, but many had received some education in England or the United States. The buildings were usually adequate, equipment was fair, and there was enough clinical material. Yet the fact that many of the schools completely failed in their purpose of graduating competent physicians was admitted by several outstanding Japanese medical educators.

The medical colleges or lower grade medical schools were entirely inadequate. They accepted students directly from middle school without any scientific background. In the 4- to 5-year curriculum an attempt was made to give the students a premedical and medical course

that would fit them for the practice of medicine. Most of the schools were privately controlled and the faculties were small and usually incompetent. In many instances the students performed menial tasks about private hospitals and medical education was a secondary issue. Students with an acceptable background or any true scientific ambitions would not attend these schools. The graduates were definitely not accepted by the better class public or by higher scientific organizations. Thus a large number of persons who were neither competent or generally accepted by the Japanese themselves graduated to practice medicine. It appears that the type of medicine they practiced was not far superior to that of the licensed practitioners of acupuncture or moxicantery or the unlicensed faith healers.

In addition to the medical schools there were nine dental colleges and 10 schools of veterinary medicine in Japan before the war with the United States. Only 1 of the dental colleges was governmental and 8 were private, while 7 of the 10 veterinary schools were government controlled.

General Effects of the War

As mentioned previously many Japanese functions were on a wartime basis beginning about the time of the start of hostilities with China in 1937. The first changes evident in the field of medical education were in 1938 and 1939. The age of induction for compulsory military service was not sufficiently low to result in any significant interference with medical education at this time.

With the advent of hostilities with the United States, government control became more stringent. In connection with the accelerated program in medical teaching, the schools graduated two classes in 1941. Due to larger classes and more schools the number of graduates continued to increase over the next few years (Table 8).

Apparently, the selection of medical students by the larger universities was made on a fair and impartial basis. Prior to the war applicants for admission were appraised on the basis of their previous school record, personal interviews and an examination in the basic sciences. During the war the Ministry of Education directed that scientific questions could no longer be asked on entrance examinations. As explained by one of the Osaka professors, the rationale of this ruling was as follows: Premedical students, both in middle and high school, worked as laborers in war plants in addition to attending school. They were not allowed sufficient time in school to really apply themselves to their subjects and thus were not prepared for such examinations. It was feared by the government that if such questions were asked, the students would realize that they were being held responsible for the material they were covering in school and would tend to shirk their war work and devote more time to their studies. Many other evidences were seen which illustrated the insincerity of Japanese authorities relative to the quality of education. While not willing to discontinue education, they continued schooling on a superficial basis but devoted most of the students' time to work in factories producing military supplies.

Further curricular changes were also introduced in the medical schools. Courses in obstetrics, pediatrics, and the basic sciences were curtailed as courses in military medicine were added. Too, the entrance requirements were lowered and the length of the medical courses were shortened (Table 9). The exact dates upon which these various changes occurred were not known since they varied from school to school.

As early as 1942 medical schools began to note shortages of supplies and equipment, and by early 1944 shortages became quite acute. Many basic laboratory exercises had to be omitted because of the lack of chemicals, and broken or worn-out equipment could not be replaced.

After compulsory military service had been in effect for several years, the shortage of young teachers became more acute. It was said that even though some of the men were being returned from military duty they had "lost their clinical touch." They had been away from the practice of medicine for such an extended period of time that they were no longer satisfactory instructors for students. The middle-aged and older teachers in medical schools were not utilized by the military services to any great extent so that the medical faculties remained fairly intact except for the young physicians.

TABLE 9.—*Schematic plan of medical education in Japan*

	Medical universities		Medical colleges	
	Prewar (years)	War (years)	Prewar (years)	War (years)
Primary school	6	6	6	6
Middle school	5	5	5	5
High school	3	2		
College			4–5	$3\frac{1}{2}$–$4\frac{1}{2}$
University	4	$3\frac{1}{2}$		

As the war progressed the draft age was gradually decreased from 27 to 23 years and a man was drafted even if he was in medical school and regardless of how close he was to graduation. It was admitted by educators that some medical students had been taken as ordinary soldiers but no estimation of the number could be obtained, as there were no records pertaining to this point. It appeared that the military was sufficiently powerful that the Ministry of Education or any other group was afraid to disagree with them when medical students were to be drafted. However, the impression obtained from many sources was that few medical students, probably less than 5 percent, were so drafted. During the last few months of the war the pressure of the military for more manpower threatened to interrupt medical education completely. It was proposed that all physically fit young men of 17 years or older be taken into the armed forces. This demand was opposed by the Ministry of Education but the issue had not been settled at the time of the surrender. Such a move would have meant the closing of practically every college and university in Japan and illustrates the desperate plight in which the Japanese found themselves in 1945.

The Effects of Bombing

Added to the general effects of war, there were many conditions which could be attributed in part to bombing.

One very serious effect on medical schools was the evacuation of supplies and valuable equipment to safer areas. Chemicals and laboratory apparatus were taken from the laboratories. School libraries were completely or almost completely withdrawn. X-ray equipment and other valuable devices were removed from teaching hospitals. The students were thus deprived of an important part of their education and the patients received poorer medical care.

By remaining in the cities, students and teachers subjected themselves to bombing which they could avoid by fleeing to the country. Many did leave; others remained only until the city had been bombed. Students could not afford to detach themselves completely for fear of induction into the military service, but they did not attend classes regularly. Often when they attended classes the instructor would not appear and the time was wasted. Morale was poor.

The amount of war duty required of students varied from one prefecture to another, and depended upon the urgency of the situation. Early in the war, in the prebombing era, students spent their summer vacations in mining areas to carry out numerous tests on miners, with particular attention to tuberculosis. They were organized in groups of 10 headed by an instructor. These assignments were probably useful from a training standpoint when there was adequate supervision of their work. As the war progressed students were mobilized for labor duties which had no relation to their professional training, such as assisting in clearing away debris in bombed plants or about the water front. In Osaka it was said that the practice became so common that it threatened to interrupt the medical school of the Imperial University. The medical authorities appealed to the local government and after considerable delay the practice was discontinued. Thereafter the students were used on air-raid rescue or first-aid teams and to conduct clinics to care for casualties. These duties often interferred with their formal education but in the emergency the medical schools could not object to this practice. Similar situations were encountered in other cities and schools.

An important factor which should not be overlooked is the effect fear had on education. After bombing began, students and teachers became tense and fearful lest they should be destroyed in the next raid, and were unable to concentrate. Many of the professors related that they noted this symptom among themselves and their students. Toward the end, many of the Japanese realized that the war was lost and wondered whether they and their families would survive until it was concluded. Despite

the fact that there was a gradual deterioration of morale, there was no evidence of suicides among the students, nor did they seem to show any increase in psychiatric disturbances. The picture was that of anxiety, with distraction and inability to concentrate.

Often after air raids there was sufficient disruption of transportation that students and teachers were either delayed or were unable to reach the schools. Even though the bombing of cities was almost entirely incendiary and consequently streetcar and railway tracks were not greatly disturbed, many cars were consumed in the flames. Operating and maintenance crews were often killed or injured, or had fled. For a period of several days after one of the large city raids, transportation was immobilized or irregular and overcrowded, and the people were forced to suspend normal activities. Medical students were busy helping to care for the injured or with other duties. In all, it is difficult to understand how many of the schools even pretended to continue in existence.

The direct and often severe effects of bombing were seen in the actual destruction of schools and hospitals and in the death or injury of students and teachers. Table 10 shows the casualties sustained and the destruction of teaching facilities. This information was obtained from the Chief of the University Section of the Ministry of Education about three and one-half months after the end of the war. It was felt to be fairly complete and accurate though at least one apparent discrepancy appears. For instance, upon visiting the Imperial University Hospital, Tokyo, it was noted that several of the buildings had been destroyed but the wreckage did not appear burned out. Upon questioning hospital authorities we were told that the hospital had not been struck by bombs. The debris on the grounds was said to be the remains of several combustible buildings which were torn down as a protective measure against indendiary raids. It was reported that in this manner the hospital had sacrificed almost half of its bed capacity in an effort to protect the less inflammable main structures. Yet the Ministry of Education reported that a part of the hospital was burned. Another discrepancy was in the reported number of casualties resulting from the atomic bombing of Nagasaki. Several local authorities reported 600 students and teachers killed, whereas the Ministry of Education stated that 399 students and 22 teachers died of the bombing. Otherwise, the material coincides with information received elsewhere.

It may be noted from Table 10 that most of the schools and hospitals were burned but that there were relatively few casualties among the students and teachers. Hospitals and medical schols were not selected targets, however, they were located in the congested, highly combustible sections and it was impossible to avoid them in the mass burning of cities.

It is difficult for Americans who are accustomed to hospitals and universities built on spacious grounds to realize at what premium ground is held in Japan, where nearly every square foot of land is utilized. Hospitals and schools are commonly surrounded by Japanese buildings of highly combustible nature. Some of the hospital buildings were relatively fireproof but nevertheless were completely gutted by flames. The fires about such buildings were so intense that windows were broken out, even metal window shutters were buckled and twisted, and inflammable interiors and furnishings were burned completely. All the contents, including medical equipment and supplies, were usually destroyed and only the shell of a building remained as evidence of a formerly impressive hospital. When the buildings were of wooden construction they were completely consumed if caught in these great fires.

Many hospitals and schools survived in the burned-out cities because they were less inflammable and/or were protected by surrounding buildings of similar construction. The Imperial University and Hospital at Osaka is an example. Others were fortunate in having considerable open space about the buildings. For instance, the Imperial University and Hospital in Tokyo, located on a beautiful, spacious campus in a densely congested section of the city was unharmed although the surrounding areas were burned to the ground. Still other hospitals and schools were partly destroyed but some of their buildings across the street or located at some distance suffered no damage from bombing. At Keio University in Tokyo nearly all of the medical school buildings and hospital containing 710 of the original 900 hospital beds were consumed in the spreading fires.

All in all, the medical schools and teaching hospitals of Japan suffered tremendous physical damage from bombing. About 20 percent of the total civilian hospital beds and an unknown amount of valuable equipment was consumed in the fires of incendiary bombing. Additional damage was inflicted by the atomic bombing of Hiroshima and Nagasaki. Generally speaking, the higher class schools suffered less damage because of more fire-resistant construction and more favorable locations. The smaller schools, the majority being of wooden construction and located in more congested areas, were usually total losses when caught in conflagrations.

Postgraduate Education

There was little postgraduate medical education in Japan even before the war. There was some graduate training of physicians in the various hospitals, particularly those associated with the medical schools of university rank. The Institute of Public Health stood out as the only formal postgraduate institution. Physicians who desired to receive formal training in other subjects usually went to medical centers in Europe or the United States.

The wartime fate of the Institute of Public Health was particularly interesting as it was not bombed, but suffered severely from war conditions and the indirect effects of bombing.

The Institute of Public Health was established under an Imperial ordinance dated 29 March 1938, and is under the jurisdiction of the Minister of Health and Social Affairs. The Institute Building was donated by the Rockefeller Foundation and was completed on 9 May 1938. Although the primary purpose of the Institute was to train public health workers, it also undertook scientific investigation and research on problems related to the health of the Japanese nation. Two practical training centers were established in connection with the Institute—the urban center in Kyobashi Ku, Akashicho, Tokyo, and the agricultural center in Sawa Machi, Saitama prefecture. These centers were operated by the city of Tokyo and Saitama prefecture, respectively, but from a practical standpoint were intended as field units of the Institute of Public Health. Training courses were provided in medicine, pharmacy, veterinary medicine and public health nursing. The fixed number of students and the amount of training was as follows: Medicine—50 students, 1 year, 1,550 hours; pharmacy—20 students, 1 year, 1,550 hours; veterinary medicine—25 students, 4 months, 468 hours. The training included field work and excursions. In addition to the regular course, special, postgraduate students were admitted to work on specific problems. The original staff consisted of a director of professional rank, 7 professors, 9 assistant professors, 9 lecturers and 19 assistants.

In 1940 the Institute for Nutrition Research and in 1941 the Institute of Physique were incorporated within the Institute of Public Health, and in 1942 the Institute of Population Problems and the Institute of Industrial Safety were added. The new Institute then consisted of five departments, each representing one of the former divisions. However, the unification was only nominal and the various units continued to function as independent institutes. A significant development in this connection was that the Vice-Minister for Health and Social Affairs became ex-officio director of the Institute. Since such an official was a layman and did not have a scientific background, this change was resented by the scientific personnel and resulted in a considerable decline in morale.

During the war the Institute suffered from increasing shortages of chemicals and foodstuffs for experimental animals. Three of the staff of 19 were taken for military service. Because of the shortage of paper, The Japanese Journal of Public Health ceased publication. The training activities of the Institute were gradually decreased each year of the war because of great need of this professional personnel for the military service. Finally, in April 1944, the Ministry of Health and Social Affairs suspended all teaching activities of the Institute except a junior course in nutrition, which was an undergraduate class. Table 11 shows the number of graduates in the various departments from the opening of the Institute through 1945.

As previously noted, the Institute sustained no direct damage from bombing, but it suffered severely from indirect effects. When Saipan was occupied by the United States in July 1944, the Japanese Ministry of Health and Social Affairs, which had been housed in barrack buildings, began searching for concrete buildings, for fear of air raids. They moved into the

TABLE 10.—*Effects of bombing on medical and dental schools, Japan*

Name	Location	Teachers and staff		Students		Degree of injury
		Killed	Injured	Killed	Injured	
Tokyo Imperial University	Motofuji-machi, Hongu-ku, Tokyo					Part of hospital burned.
Osaka Imperial University	Tsuneyasu-cho, Kita-ku, Osaka	6	5	8	8	Attached medical school completely burned.
Nagoya Imperial University	Tsurumai-cho, Showa-ku, Nagoya					Mostly burned.
Okayama Medical College	Oka, Okayama City	4	2	6	4	Hospital mostly burned.
Chiba Medical College	Yasaku-cho, Chiba City	4		3	3	Seven schoolrooms and hospital burned.
Kumamoto Medical College	Hanzyo-machi, Kumamoto City					Mostly burned.
Keiogijiku University	Shinano-machi, Yotsuya-ku, Tokyo		2		1	Completely burned.
Nihon University	Ouyaguchi, Itabashi-ku, Tokyo			1	15	Half burned.
Tokyo-jikeikai Medical College	Atago-cho, Shiba-ku, Tokyo					Mostly burned.
Nihon Medical College	Komagomesendagi-cho, Hongo-ku, Tokyo			4	111	Completely burned.
Aomori Medical College	Aomori City		1	1		Do.
Tokushima Medical College	Showa-machi, Tokushima City					Attached hospital completely burned.
Mie Prefectural Medical College	Shimabuda, Tsu City	2	2			Do.
Yamanashi Prefectural Medical College.	Higashi-Aonumamachi, Kofu City					School and attached hospital completely burned.
Nagoya Municipal Women's Medical College.	Mizuho, Mizuho-ku Nagoya City					Part of school burned.
Gifu Prefecture Women's Medical College.	Hongo-ku, Gifu City			1		School building completely burned.
Tokyo Medical College	Higashi Oukubo machi, Todobashi-ku, Tokyo.					Mostly burned.
Showa Medical College	Nakabu-cho, Ebara-ku, Tokyo			2	6	Not burned.
Jintendo Medical College	Hongo, Hongo-ku, Tokyo	2		2		7 attached buildings burned.
Tokyo Women's Medical College	Ichigaya-Kawada-cho, Ushigome-ku, Tokyo	3		6		Completely burned.
Maibashi Medical College	Imagaim-cho, Maibashi City	1				Part of attached hospital burned.
Osaka Woman High Medical College.	Maikata-cho, Kitakawachi-gun, Osaka			3	1	Partly damaged.
Yamanashi Prefecture Women's Medical College.	Ishima-machi, Higashi-yashiro gun, Yamanashi ken.	1		1		School and hospital completely burned.
Tokyo Dental College	Misaki-cho, Kanda-ku, Tokyo	3		5	4	Mostly burned.
Nihon Dental College	Misaki-cho, Kojimachi-ku, Tokyo			7	8	Part of school and hospital burned.
Osaka Dental College	Maikata-machi, Kawachi-gun, Osaka		2	3	3	Part of school damaged.
Tokyo Women's Dental College	Moto-machi, Hongo-ku, Tokyo	1		4	1	School and hospital completely burned.
Nihon Women's Dental College	Kitosensoku-cho, Omori-ku, Tokyo		1	3	2	School was not burned.
Atomic bombings						
Nagasaki Medical College	Satokuni, Nagasaki City	22		399		Completely burned.
Hiroshima Prefecture Medical College.	Minami-cho, Hiroshima City	1	1			Entire school building collapsed.

Institute of Health, taking over the dormitory, all of the students' laboratories and lecture rooms, and a greater part of the research laboratories and offices. This aroused much indignation on the part of the staff of the Institute and some of the more prominent staff members resigned.

In April 1945, after the bombing of Tokyo became intense, the Institute was ordered to evacuate. The personnel and equipment was dispersed to three small urban areas, leaving only a few key staff members and the business section of the Institute in Tokyo. When the bombing of smaller cities started, a second evacuation to still more rural areas was effected. Though this procedure did preserve many of the instruments, some were damaged in moving, and the activities of the Institute were completely paralyzed.

At the time the Institute was visited last by the Medical Division of the Survey, in late November 1945, there was no evidence of restoration. The Ministry of Health and Social Affairs still occupied the buildings and no personnel or equipment had been returned. The Institute existed in name only, but still maintained a skeleton staff (Appendix A–7).

The only other postgraduate schools which were active in Japan during the war were the Army and Navy Medical Schools, both located in Tokyo. Students applied for commissions in the service of their preference. When accepted the students were commissioned and upon graduation were appointed officers in the medical department. They then entered the service medical school for training in military medicine. Prior to the war with the United States the course lasted one year but during the war it was decreased to 8 to 10 months.

Interesting situations arose in many instances in connection with recent medical graduates and the military services. Some of the students were not anxious to serve and did not apply for either army or naval commissions. The military services became irate and inducted these recent graduates as ordinary soldiers and never used

TABLE 11.—*Graduates of courses, institute of public health, Japan*

Year	Medical	Pharmaceutical	Veterinary	Nutrition		Public health nursing
				Senior	Junior	
1939	33	21	21	0	0	0
1940	34	10	20	0	0	20
1941	14	16	27	0	96	16
1942	15	19	9	19	93	44
1943	8	12	13	19	103	23
1944	0	11	18	0	98	0
1945	0	0	0	0	57	0
Total	104	89	108	38	447	103

them as medical officers. This occurred in isolated instances at many of the medical schools early in the war but became more frequent as the war progressed, and nearly half of the 1945 graduating class at the Osaka Imperial University was inducted into the army as ordinary soldiers.

Post-War Status

During the four months after the surrender, medical education in Japan, as did many other activities, remained almost in a state of suspended animation. The complete deterioration of the entire program showed little evidence of recovery. Of course, the majority of the remaining medical schools were in operation, but lacked spirit and efficiency. Hospitals were functioning and young physicians were receiving hospital training of a sort. In most of the hospitals, however, supplies were very low. Most of the evacuated equipment had not been returned. In a few instances, libraries and some equipment were being returned piecemeal. By far the greatest problem faced by hospitals, and by the general population, continued to be that of obtaining adequate food.

It is difficult to predict the future of Japanese medical education. There are a few well-trained educators who are cognizant of the shortcomings of the previous methods and are interested in evolving a more thorough educational program. There are a number of teaching hospitals which have encouraging possibilities. Given the right guidance and support, rapid strides could be made toward a system which would succeed in producing capable physicians. After all, the Japanese have made tremendous strides since 1848 when no scientific medicine was practiced in Japan. Even during the period since then, stringent restraints towards further development have been in effect at times. More rapid strides in the future are possible if developments are directed by medical educators instead of politicians.

MEDICAL PERSONNEL

As indicated in this report, the quantity of medical personnel in Japan before the war with the United States was fairly adequate. The number in proportion to the population compared favorably with that of the Western world. However, the quality was far inferior, and therein lay the principal difference between the medical personnel in the Far East and the rest of the world.

In discussing medical topics in relation to Japan it should never be forgotten that the Japanese had no modern science until about 1848, when the country was partially opened to the rest of the world. Prior to that time the only Japanese medicine practiced was a type of oriental medicine without scientific background. It was based almost entirely on ignorance, superstition, and certain religious beliefs. Even after 1848 the Japanese were very slow to accept practices and customs of the rest of the world. The large percentage of the population was kept relatively uneducated, economically subservient, and blindly faithful.

The field of medicine, as well as science in general, has not kept up with the progress in industry, but within the past two decades there have been definite advances. Some Japanese medical men and other scientists studied in the Western world and returned to Japan with the more progressive ideas. As mentioned previously, systems of training medical personnel have been brought into Japan from other countries and a few of the schools have been quite progressive.

The greatest fault with the Japanese in their period of development has been their unwillingness to see the truth even when it was obvious. They have often built a fine organization on paper and refused to recognize that at the functional level it was completely different and ineffectual. They continued to graduate physicians from inferior schools because it looked better on the surface to have a certain number of graduates and so many doctors per unit of population. The government allowed the training of nurses in abominable institutions because they felt that it looked well to have a certain

number of nurses graduating and practicing. It looked better on paper to have 1,000 public health nurses regardless of their training than to have 500 who were well trained and competent.

There has been very strong government control of Japanese medicine. The controls were divided between the central government and the prefectural governors, and were usually adopted because of their policing value rather than their possible supportive nature. An indication of this is that many of the so-called public health functions have been in the hands of the police. For instance, the examination of prostitutes was required at regular intervals, but the examinations were a farce. They not only did not accomplish anything from a scientific standpoint but were dangerous since they resulted in a false sense of security and the accumulation of much inaccurate data. Actually, these examinations were not required in order to prevent the spread of disease, but to make pretenses in that direction, and to afford the police an easier system of checking on prostitutes' licenses.

The whole system of such fallacious and pretentious reasoning has resulted in a large number of poorly trained persons being expected to do a job of which they were not capable. Many of the doctors, nurses, and other personnel graduated from inferior schools. They were required to go through maneuvers that had no scientific basis and were thus encouraged in a pretentious and false existence.

One of the most startling examples of such procedures was the use of BCG vaccine in prophylaxis against tuberculosis. The Japanese have used this vaccine extensively within the past few years and have copious volumes of data upon its effectiveness. The results of this work appeared very significant until the data and methods were examined more closely, when it actually appeared that the work was set up in such a manner that it could not be interpreted impartially and accurately. For instance, the Japanese would not diagnose tuberculosis of the lungs unless the tubercle bacillus was found in the sputum ("open cases"). Cases showing definite infiltration of the lung on X-ray or other evidence of tuberculosis which would not be questioned in Europe or the United States, were called "infiltration of the lung", pleurisy, or some other equally evasive term. In the Japanese study, detailed statistics were collected on the open cases and their deductions and conclusions were on this basis. The minimal and closed cases were not considered. It had been shown everywhere else in the world, and this fact was known to the Japanese, that open cases of tuberculosis are late manifestations of the disease and represent a small percentage of the cases if adequate methods of detection are used. Yet the Japanese set up and carried out a vast study on the prevention of tuberculosis when the basic facts upon which any evaluation must rest were entirely fallacious. It appeared that they had previously decided the answer to a problem and then had erected an equation which could give no other answer.

Apparently the adequacy of any Japanese medical procedure could not be appraised on the basis of the quantity of personnel involved, nor on the face value of reports on procedure. This must be borne in mind constantly when studying Japanese reports and when attempting to evaluate their procedures.

Physicians

Upon graduation from medical schools recognized by the Ministry of Education, physicians were automatically licensed to practive anywhere in Japan. Graduates of foreign schools or unrecognized Japanese schools were required to pass an examination before they were allowed to practice. The number of foreign school graduates has always been very small, and practically all of them were Japanese or of Japanese ancestry, but the number of graduates of unrecognized schools have been considerable. All licensed physicians are members of the Medical Practitioners Association of Japan (Nihou Ishikai).

Graduates from institutions of university rank have the degree of "Gakushi", meaning "university graduate." Those graduating from lower ranking institutions (medical colleges) are simply "physicians" (Ishi, Isha), and have very little prestige as compared with the former group. In addition, all graduates could obtain the degree of Doctor of Medicine (Igaku Hakushi Igaku Hakase) by extensive postgraduate studies and the submission of a thesis, but only a fraction of the total number of physicians acquired this academic doctorate. Those who

did were almost entirely in the field of academic medicine.

Private medical practice forms the basis of the Japanese medical system, however, there are a number of government organizations for medical practice. The government group consists largely of nonprofit hospitals and dispensaries for the diagnosis and treatment of special diseases, such as infectious diseases, tuberculosis, leprosy, venereal and mental diseases, plus some groups doing general practice in connection with railroads and other government owned enterprises. A fair number of privately owned industries also maintained their own medical care programs.

Table 12 shows the total number of physicians, the number in practice and the physician-population ratios from 1935 to 1944. The distribution of medical practitioners by prefecture for 1938 and 1945 is shown in Appendix A–8. The most detailed prewar figures available were for 1938, at which time there was a total of 62,934 physicians, of whom 51,837 practiced. In other words, there was one practicing physician for 1,393 inhabitants or 7.18 physicians per 10,000 population. The comparative figures of the distribution of physicians in rural and urban areas of the United States and Japan are shown in Table 13. It will be noted that the same trends existed in Japan as in the United States, with a much higher physician-population ratio in the urban than in the rural areas. Viewing it as a whole, the United States had about three physicians to Japan's two per unit of population; these ratios applied to rural and urban areas of the two countries as well.

Reference to Table 12 reveals that during the past 10 years the total physicians in practice in Japan has varied from 82 to 92 percent. As would be expected, the latter figures were for 1944. At this time Japan was making its greatest war effort and the demand for practicing physicians was at its peak. The difference between the total number of physicians and those in practice was accounted for by the numbers of those in the public health service and others engaged in teaching and research. Probably also included in this group were all of those physicians who were not in active practice because of disabilities or other reasons.

A classification of physicians for 1938 is shown in Table 13. Of additional interest in this regard is the large number of physicians who were not graduates of recognized schools. About 14 percent of the Japanese physicians for that year fell into this group.

The draft of physicians had begun several years before hostilities with the United States, and the period from 1937 to 1941 was one of gradually tightening military restrictions. The total number of physicians (exclusive of those in the military service) reached its peak in 1940 with 65,332, though the largest number of practicing physicians was in 1937. Thus it was apparent that the degree of mobilization prior to war with the United States was not severe enough to seriously effect the number of physicians in civilian practice. The principal difficulty encountered in connection with mobilization prior to 1941 was the loss of young physicians. Up until then there had been very little actual disturbance of the civilian practice of medicine and very few physicians were casualties.

TABLE 12.—*Numbers of physicians, practicing physicians and physician-population ratios, Japan, 1935–44*

Year	Total number of population	Number of physicians		Percent of Practitioners	Ratio per 10,000	Ratio per 1,000 for one practitioner
		Total	Practitioners			
1935	69, 254, 148	57, 581	51, 597	90	7. 45	1. 342
1936	70, 258, 000	59, 716	53, 180	89	7. 57	1. 321
1937	71, 252, 800	61, 799	54, 481	88	7. 65	1. 308
1938	72, 222, 700	62, 934	51, 834	82	7. 18	1. 393
1939	72, 825, 800	64, 234	54, 416	85	7. 47	1. 338
1940	73, 114, 308	65, 332	53, 954	83	7. 38	1. 355
1941	74, 140, 000	55, 302	49, 045	89	6. 62	1. 512
1942	74, 140, 000	48, 488	44, 660	82	6. 02	1. 660
1943	74, 560, 000	50, 417	43, 833	87	5. 88	1. 701
1944	72, 917, 000	49, 077	44, 983	92	6. 17	1. 621

Source: Ministry of Health and Social Affairs.

With the advent of war with the United States the entire Japanese war economy became more stringent. The number of physicians inducted into the armed forces increased more rapidly than it had done for the past 5 years. Though more physicians were being graduated, the military demands were so great that the number of physicians available for the civilian population progressively decreased. Reference to Table 12 shows the decline from 65,332 in 1940 to 49,077 in 1944. The change in the number of public health officials in Japan from 1942 to 1944 is shown in Appendices A–9, A–10 and A–11. There were decreases in the civilian population during this period but the decrease in the number of physicians was proportionately much greater.

TABLE 13.—*Comparative numbers and Distribution of physicians in Japan and United States, prewar and 1944*

	Japan				United States			
	1938			1944 Total	1940			1944 Total
	Rural	Urban	Total		Rural	Urban	Total	
Total number physicians			62,934	49,077			175,146	117,578
Physicians per 10,000 population	4.62	11.93	8.75	6.73	6.68	14.1	13.30	9.20
Persons per physician	2,164	846	1,141	1,486	1,498	710	751	1,082

The difficulties encountered by physicians were common to the Japanese people as a whole prior to bombing. There were shortages of food, supplies and equipment, which imposed increasing burdens on the practicing physician.

TABLE 14.—*Classification of physicians in Japan, 1938*

Graduates of Imperial universities	22,952
Graduates of recognized schools	23,612
Women graduates	3,951
Graduates of foreign universities	74
Women graduates of foreign universities	7
Physicians passing examination, but not graduates of recognized medical schools:	
Men	8,664
Women	306
Otherwise licensed physicians, including physicians licensed for limited districts	368
Total	62,934
Physicians actually engaged in medical practice	51,837
In cities	30,455
In towns	10,484
In villages	10,898

When Japan began to experience intense and repeated bombing, the burden on the sharply decreasing number of physicians became increasingly great. Due to food shortages and other effects of war, the health of the nation was poorer than it had been in the early war years. Preparations for air raids required a portion of the doctor's time. There was also the problem of the large numbers of air-raid casualties which required considerable attention.

In addition to the increasing load, the Japanese physician also suffered direct physical and material damage as a result of the air raids. The Medical Practitioners Association of Japan reported that 52 physicians were killed by bombing in Tokyo, and 200 to 300 in all of Japan. At least an equal number were injured. It was estimated that about 80 percent of the doctors in Osaka suffered from some "air-raid disaster." Some were killed in the raids, others were injured, and still others had their offices and equipment destroyed by bombing. Some of these physicians were able to continue in private practice and others joined the full-time staffs of hospitals.

However, the poor recuperative powers and lack of initiative of the Japanese became evident here as in many other fields. Though one would have expected them to continue practice even in the face of difficulties, time and time again Japanese physicians and other officials reported instances where the doctors just completely stopped work. Even those physicians returning from military service rarely went directly into practice. Many did accept positions in hospitals but many others felt that they could do nothing because they had so little with which to work.

As there were no large evacuations of the Japanese cities before bombing actually started, the number of physicians who fled was roughly in proportion to that of the general population. After bombing started, many physicians, as did other inhabitants, fled the cities because of fear or because of the destruction of their homes and offices. The reason that the loss of physicians was not more seriously felt in the cities was due to a comparable decrease in the population. The physicians who remained but did not practice represented the principal loss in doctor-population ratio.

At the time the survey was made, no more accurate figures could be obtained than those given by the Medical Practitioners Association on the number of physicians killed or injured in air raids. Estimates placed the number of doctors killed as high as 10 percent in several of the large cities which had been subjected to intensive incendiary bombing. These estimates were probably high since they were so much greater than that of the general population, when there was little reason to account for such disproportion. Over-all mortality rates in the bombed cities were about 1.3 percent of the population. The rate for physicians may have been higher but it does not seem reasonable to believe that they could have been more than twice as great. Such losses of medical personnel

ordinarily would not have been critical to a medical care program, but conditions in Japan were so severe that even small losses would have appeared disproportionately great. With the loss of physicians because of the demands of the armed forces and other factors mentioned, the Japanese population was extremely short of medical care.

It was more difficult to evaluate this critical loss in Japan than it would have been in the United States. The Japanese people had never become sufficiently dependent upon the legitimate medical profession to feel a comparable loss as greatly as would the people of the United States. Certainly the Japanese suffered from the deterioration of the medical care program, but there were so many other disturbances of their lives at the same time that the medical loss is difficult to appraise in itself. But because they came on top of such severe wartime conditions the effects of bombing upon the medical profession in Japan were more critical than they might have been otherwise. Though this condition must have contributed to ending the war, no outstanding features in this direction could be ascertained.

Nurses

Nurses have never occupied an enviable position in Japan. Usually they came from the lower classes, did not receive much respect, were inadequately trained, and poorly paid. Their importance in the medical care program of Japan has been far less than that of nurses in the rest of the world, especially the United States.

The difference between nurses in the two countries is based on many factors. Most nurses are women and the oriental attitude concerning the subservience of the female has had considerable influence on the Japanese attitude. Too, the common practice that a member of the patient's family remained in the hospital to administer bedside care has obviated some need for nurses and tended to decrease their importance.

The position of nurses in Japan has been somewhat comparable to attendants or war aids in the United States medical system. Most Japanese hospitals did not require them to complete a middle school education before entering nurse training. The length of the training course varied from 2 to 3 years but during this time they were often used as a source of cheap labor instead of being trained as students. The licensing of nurses in Japan has been in the hands of the prefectural governments and there were wide variations in the requirements.

TABLE 15.—*Bedside and public health nurses, Japan*

Year	Bedside nurses total	Public health nurses			
		Total	Licenses granted by		
			A	B	C
1938	114,678				
1939	121,059				
1940	130,425				
1941	141,915	4,500			4,500
1942	85,545	9,604	1,300	3,804	
1943	94,856	10,647	4,347	1,800	
1944	94,861	12,100	4,600	3,000	
1945	98,244	13,071			
Total			10,247	8,604	4,500

A—Graduates from schools of public health nursing.
B—Nurses without public health training, licensed by examination.
C—Obtained license by "additional regulation of public health nurses."

There were no regulations pertaining to the licensing of public health nurses in Japan until 1941. Prior to this time those nurses who were "engaged in public health work and had shown prominent abilities in this direction" were granted licenses without examination. In 1941 the central government established regulations providing for the licensing of those graduates of schools of public health nursing designated by the Ministry of Health and Social Affairs. In 1944 the responsibility for appointment of schools was shifted to the prefectural governors. Table 15 shows the number of public health nurses licensed each year and the total number from 1941 to 1945. There were 4,500 licenses issued in 1941 on the basis of the type of work being done. Thereafter, a considerable number were graduated from recognized schools and a slightly smaller number were licensed by examination. The total number of public health nurses increased from 4,500 in 1941 to 13,071 in 1945. This increase in the number of public health nurses during wartime would be an impressive figure if no consideration were given to the caliber of these nurses. Reference to Table 11 shows that the Institute of Public Health graduated only 103 nurses during the period 1939 to 1945. Thus only 103 of 10,247 (about one percent) of the public health nurses graduating from recognized schools were from

the Institute, which was practically the only satisfactory training center in Japan.

The other large group of nurses in Japan is referred to as bedside nurses. They are the general duty nurses who have been licensed by graduation from recognized schools or by examination. In 1941 there were 9,953 graduates and 13,047 who passed nurses examination. During this year 5,302 nurses returned their license to the government, resulting in a net increase of 17,797 nurses. Comparable figures are not available for more recent years but the total number of bedside nurses from 1938 to 1945 are shown in Table 15. There was a consistent increase from 114,678 in 1938 to 141,915 in 1941. The following year there was sharp decline to 85,545 as a result of the large number of nurses taken into the military service. At this time the government encouraged an increase in enrollment, increased the number of schools, and was more free in granting licenses to persons taking the examination. As a result the number of nurses increased sharply in 1943, remained about the same in 1944, and showed another significant increase in 1945. These gains were made despite the continued large requirements of the military. Here again, the numbers are impressive until the type of training is considered. Actually it amounted to the licensing of practically anyone who was willing to do nursing regardless of her ability.

The conduct of nurses during the war was similar to that of the general population. There were no abrupt changes in distribution until the onset of intense bombing of the cities, when nurses fled along with the general population. For example, of the 26,200 nurses in Tokyo prior to the bombing, only 3,600 remained in September 1945. Of course, some of these losses were due to air-raid casualties, but no exact figures could be obtained. St. Luke's Hospital, Tokyo, had no casualties among the nursing personnel, but 100 of the original 150 fled in fear of bombing. It was interesting to learn that at this hospital the student nurses remained on the job almost without exception but the large majority of the graduates left.

A similar situation was encountered in practically every Japanese city which was subjected to intense bombing. An unknown number were killed in the raids, but by far the large majority fled the cities without regard for their duties. This loss of personnel imposed a great burden upon the remaining hospitals. Several of the hospital officials stated that there was nothing they could do to hold nurses, doctors or others when they wanted to leave. At the time the Medical Division visited Japan, a large majority of the nurses still had not returned to the cities and their positions. Some hospital officials wanted to penalize them for desertion but the nurses were needed so badly that there seemed to be no practical way to do this.

Dentists

The organization of the dental profession in Japan is similar to that of the medical profession. There are prefectural dental societies in which membership is compulsory and these societies are combined to form the Japanese Dental Association.

In 1938 there were nine dental colleges in Japan, one governmental and eight private. Two of the private schools were for women. Dentistry is looked upon more as a luxury than as a health need and the schools are not of a high caliber. There are no dental colleges which compare with the medical schools of university rank, and dentists in Japan do not occupy a professional position comparable to that of physicians.

There were 22,735 dentists, including 1,737 women, in Japan in 1938. Of these, 12,288 were practicing in cities, 5,398 in towns and 2,466 in villages. The remaining 2,583 were engaged in public health work, administrative positions, teaching and research, or otherwise not engaged in practice. In addition, 79 physicians had specialized in dental surgery. The ratio of dentists per 10,000 population was 2.79 in 1938 and 2.24 in 1945, representing a decrease of 5,239 dentists over this period in contrast to the previous increase of 3,737 from 1934 to 1938.

TABLE 16.—*Number of physicians, dentists, pharmacists and nurses in Japan for the period 1936 to 1945*

Year	Physicians	Dentists	Pharmacists	Nurses
1936	59,716	21,067	26,732	113,987
1937	61,799	22,072	28,156	119,843
1938	62,934	22,735	28,766	114,678
1939	64,234	23,311	29,833	121,059
1940	65,332	23,214	31,094	130,425
1941	55,302	20,771	27,147	104,770
1942	48,488	19,508	27,350	85,545
1943	50,417	19,784	27,068	94,856
1944	49,077	19,051	27,250	93,518
1945	39,269	17,438	27,873	96,846

Source: Public Health and Welfare Section, SCAP.

The position of the Japanese dentists during the war differed from that of other medical personnel principally in their treatment by the military service. Only about 10 percent of the dentists in the services were serving in their professional capacity. At the end of the war there were 4,000 dentists in the armed forces, and 3,600 of them were serving as ordinary soldiers.

The experience of Japanese dentists appears to have been comparable to that of the population as a whole except as mentioned above.

Others

The outstanding school of veterinary medicine in Japan is connected with the Faculty of Agricultural Sciences of the Tokyo Imperial University. At the outbreak of the war, there were three other schools associated with the Imperial universities, seven government schools of college rank, and three private schools. In addition to the civilian schools an Army Veterinary School with about 300 students existed during the war.

Civilian veterinarians were drafted during the war and at the time of the surrender there were several thousand in the military services. The Army used them almost exclusively to carry out health measures for livestock.

Midwives in Japan have occupied a fairly important position because they attend the large majority of the births. They must complete a course at an approved hospital. In 1938 there were 62,209 midwives in Japan or 8.61 per 10,000 of population. Of these midwives, 27,955 practiced in cities, 12,839 in towns and 21,415 in villages. No exact data could be obtained on what happened to them during the war. Since the number of physicians was so sharply decreased it might be expected that the midwives by necessity would have increased, but there is no data to indicate whether or not this happened. The fate of midwives as a result of bombing was probably the same as that of the rest of the population.

Comparative figures by prefectures for nurses, veterinarians and pharmacists in Japan for 1938 and 1945 are shown in Appendix A–12.

III. FOOD SUPPLY AND NUTRITION

FOOD CONSUMPTION LEVELS IN WARTIME JAPAN

The flow of food through the supply channels of any nation may be restricted crucially at any of its critical points: agricultural production, food imports, the preservation of food products through processing, the storage of foods and their distribution Any such restriction would cause a curtailment in the supply of food to the ultimate consumers of that nation and would constitute a serious threat to their health, their ability to work and to resist attack and, ultimately, to their very lives and social organization.

The statistical data on the changes in availability of food supplies to the Japanese civilian are insufficient to permit detailed conclusions. Also lacking is sufficient scientific knowledge by which to evaluate precisely the nutritional value of the individual Japanese wartime diet. However, the data and knowledge at hand are conducive to general exposition, comparative analysis and, at least tentatively, interpretation.

It appears unlikely that substantial revisions of the data on the availability of commodity supplies in Japan during the war will be possible in the future due to the ravages of the war in the home islands. More detailed and more accurate nutritional analysis of these data, however, will be possible as scientific knowledge of Japanese foods and nutritional requirements advances.

The Supply Picture

Home Island production.—In determining the agricultural output of any country the area of land under cultivation, the number of farm laborers, the degree of mechanization and the availability of fertilizers are the principal elements under the control of man. A study of these elements therefore, may be used as a means of determining the effect of war on the food supply of that country. In this section a partial appraisal of Japanese Home Island food production is presented.

It is apparent from the data presented in Table 17 that the total production of cereal crops in Japan for any year did not vary linearly with the acreage under cultivation during that year. It may also be noted that the per acre yield of these crops, except that of rice, tended to decline during the war years. Of the factors contributing to these changes, in addition to the effect of fertilizers, a full discussion is given in the report of the Manpower, Food and Civilian Supplies Division of the Survey. This discussion may be summarized as follows:

The rate of net acreage contraction increased from 1940 through 1944 due principally to abandonment and to the establishment of new building sites. The agricultural labor force not only declined significantly in total number chiefly due to military conscription, but also in efficiency due to considerable changes in age and sex composition. The cumulative effect of many small factors including farm implements, draft animals and insecticides is not specifically measurable, but it is estimated to have been large. In addition, unusually poor weather during the growing seasons affected Japanese production during 1941 and 1945.

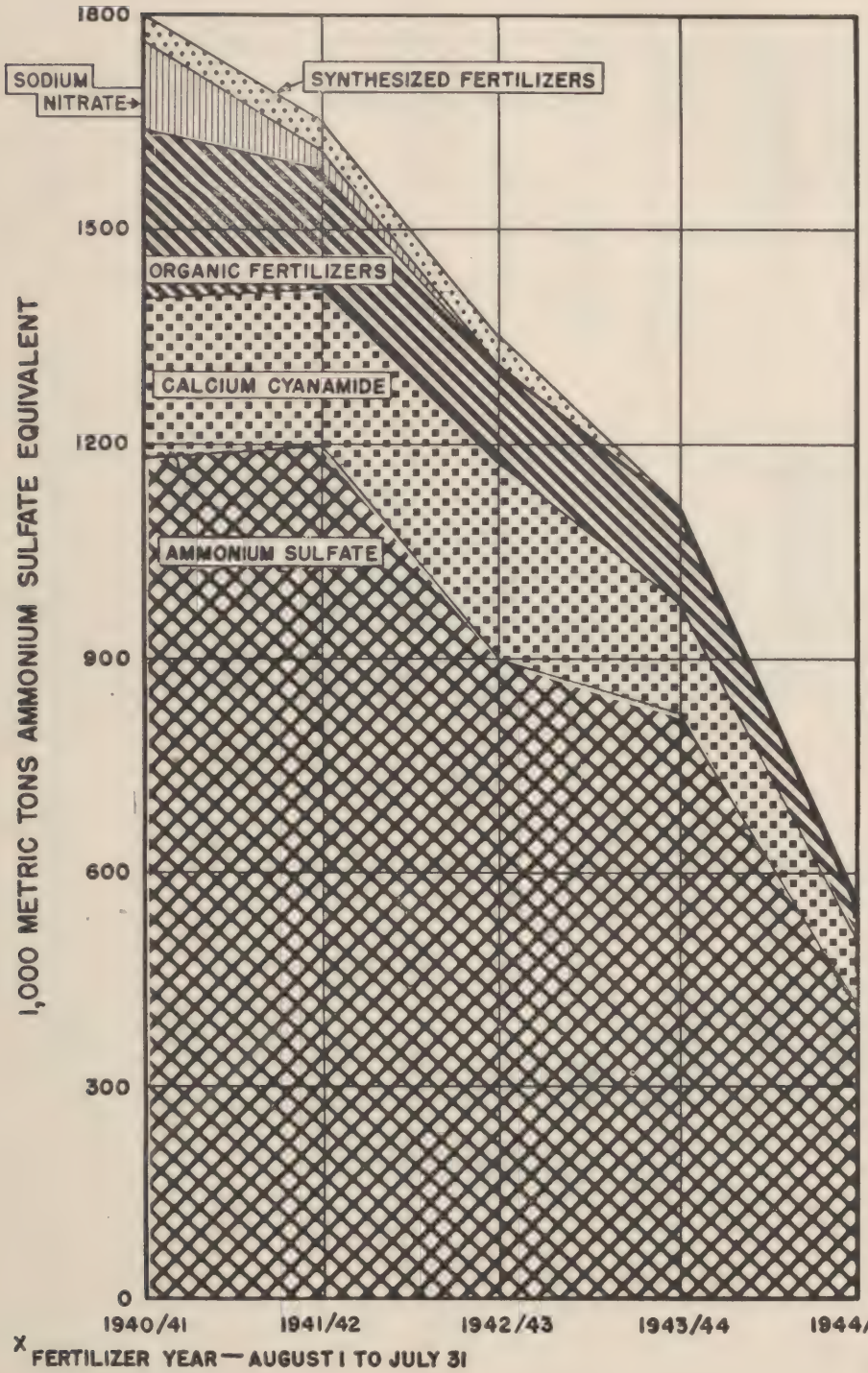
In Japanese non-agricultural food production the fishing industry is the largest single factor. From 1939 to 1945 the domestic fishery yield declined 57 percent. However, due to the transfer of the use of fish as stock feed to direct human consumption and the virtual cessation of exports the quantity available for food decreased only 35 percent. Unequal allocation to the armed forces caused a greater decline than 35 percent for civilians alone. The chief causes of the decline in the production of fishery products were the reduction in the number of persons engaged in the industry, an unfavorable change in the age composition of this group, the commandeering of fishing vessels for direct war use, shortages of equipment and fuel, and restriction of fishing areas due to war risks.

Fertilizer consumption.—Because of the intensive nature of Japanese agriculture, the food supply of Japan depended vitally upon the availability of fertilizers of all types. The considerable loss in fertilizer production which occurred in the Home Islands during the war years caused a significant decrease in consumption as may be seen in Tables 18, 19 and 20 and Figures 2, 3 and 4.

CONSUMPTION OF

NITROGENOUS FERTILIZERS IN JAPAN

1940/41 — 1944/45 X

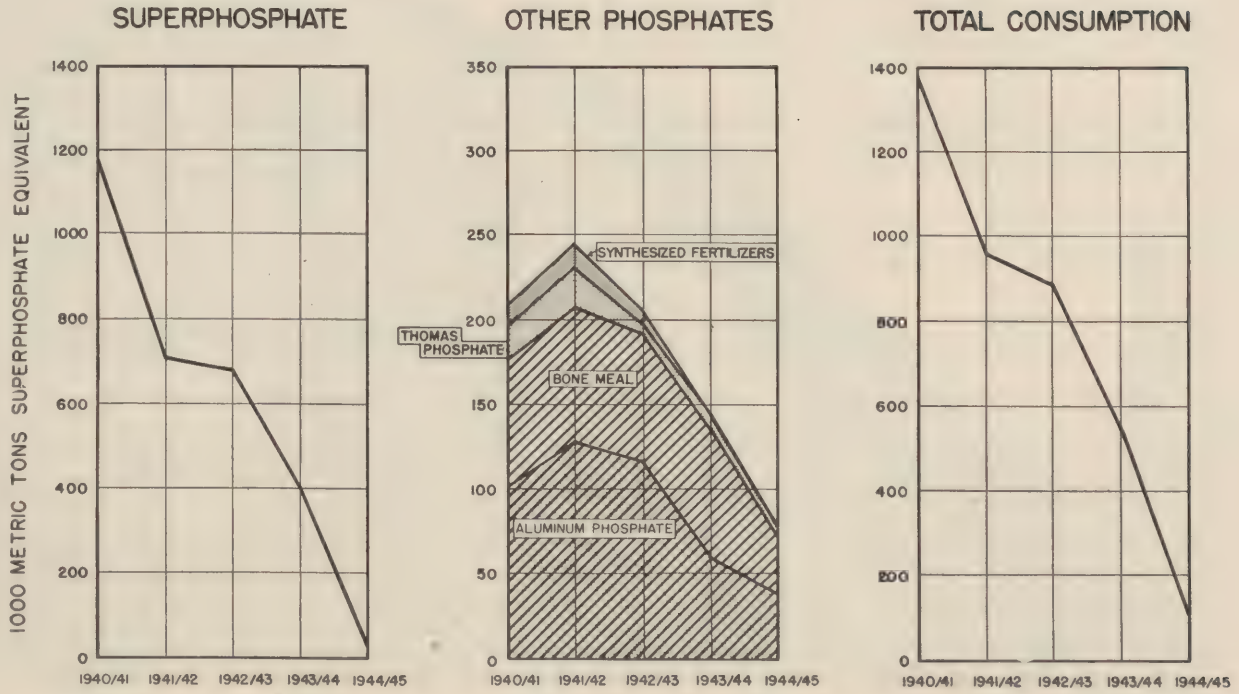


X FERTILIZER YEAR — AUGUST 1 TO JULY 31

FIGURE 2

CONSUMPTION OF PHOSPHATIC FERTILIZERS IN JAPAN

1940/41-1944/45[X]

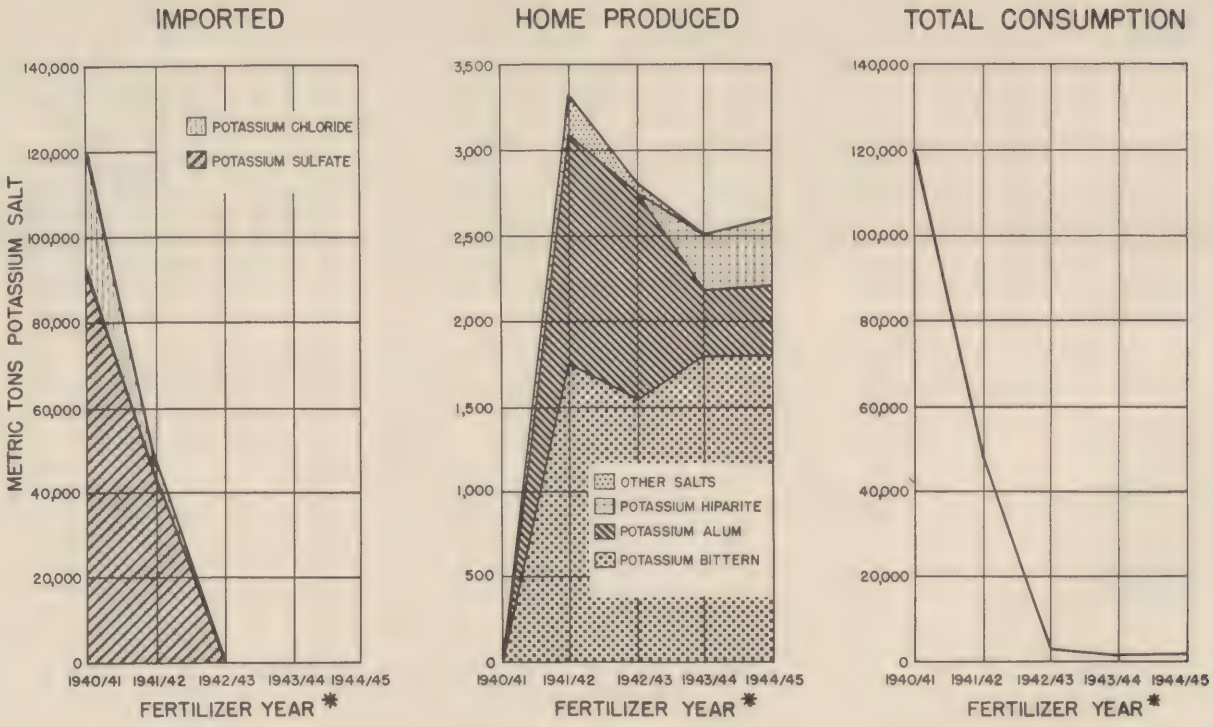


[X] FERTILIZER YEAR – AUGUST 1 TO JULY 31

FIGURE 3

CONSUMPTION OF POTASSIUM FERTILIZERS IN JAPAN

1940/41-1944/45 *



* AUGUST 1 – JULY 31

FIGURE 4

TABLE 17.—*Annual domestic cereal production, Japan, 1931–45*

Year	Rice			Wheat			Naked barley			Barley		
	Area	Production	Yield	Area	Production	Yield	Area	Production	Yield	Area	Production	Yield
1931	7,963	9,202	1.16	1,225	899	0.73	1,176	904	0.77	931	801	0.86
1932	7,987	10,065	1.26	1,250	902	0.72	1,176	910	0.77	931	823	0.88
1933	7,767	11,604	1.49	1,510	1,098	0.73	1,078	742	0.69	858	751	0.88
1934	7,767	8,640	1.11	1,590	1,295	0.81	1,029	855	0.83	809	738	0.91
1935	7,840	9,576	1.22	1,627	1,323	0.81	1,078	919	0.85	833	791	0.95
1936	7,865	11,223	1.43	1,688	1,228	0.73	1,078	810	0.75	833	690	0.83
1937	7,889	11,053	1.40	1,776	1,369	0.77	1,054	827	0.78	809	747	0.92
1938	7,889	10,978	1.39	1,776	1,323	0.74	1,005	710	0.71	882	687	0.78
1939	7,816	11,494	1.47	1,828	1,659	0.91	1,005	933	0.93	858	844	0.98
1940	7,786	10,047	1.29	2,060	1,794	0.87	992	869	0.88	833	817	0.98
1941	7,796	9,181	1.18	2,024	1,461	0.72	1,152	936	0.81	882	706	0.80
1942	7,752	11,129	1.44	2,114	1,386	0.66	1,247	918	0.74	980	733	0.75
1943	7,620	10,481	1.38	1,985	1,095	0.55	1,188	732	0.62	931	572	0.61
1944	7,320	9,778	1.34	2,058	1,385	0.67	1,245	912	0.73	1,049	781	0.74
1945	(1)	(1)	(1)	(1)	895	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Average:												
Prewar			1.32			0.78			0.80			0.90
Wartime			1.45			0.65			0.73			0.73

1—Figures not available.
Area—in 1,000 acres.
Production—in 1,000 metric tons.
Yield—in metric tons per acre.
From Ministry of Agriculture and Forestry.

TABLE 18.—*Consumption of nitrogenous fertilizers, Japan, 1940–41—1944–45**

[In 1,000 metric tons ammonium sulfate equivalent]

Fertilizer year*	Ammonium sulfate	Calcium cyanamide	Organic fertilizers	Sodium nitrate	Synthesized fertilizers	Total
1940–41	1,180	220	234	135	36	1,805
1941–42	1,196	220	178	23	36	1,653
1942–43	999	170	148	----------	33	1,350
1943–44	823	160	121	----------	13	1,117
1944–45	413	107	20	----------	1	541

* Fertilizer year begins Aug. 1; ends July 31.

TABLE 19.—*Consumption of phosphatic fertilizers, Japan, 1940–41—1944–45**

[In 1,000 metric tons superphosphate equivalent]

Fertilizer year*	Superphosphate	Synthesized fertilizers	Thomas phosphate	Bone meal	Aluminum phosphate	Total
1940–41	1,169	100	77	22	10	1,378
1941–42	704	123	86	23	14	950
1942–43	676	115	76	7	5	879
1943–44	400	58	76	10	----------	544
1944–45	14	35	35	2	----------	86

*Fertilizer year begins Aug. 1; ends July 31.

TABLE 20.—*Consumption of potassium fertilizers, Japan, 1940–41—1944–45**

[In metric tons of potassium salt]

Fertilizer year*	Imported		Home produced				
	Potassium chloride	Potassium sulfate	Potassium bittern	Toasted potassium alum	Toasted potassium hiparite	Others	Total
1940–41	93,503	27,955	----------	----------	----------	----------	121,458
1941–42	43,657	969	1,700	1,400	----------	170	47,896
1942–43	----------	----------	1,560	1,230	----------	20	2,810
1943–44	----------	----------	1,800	380	330	----------	2,150
1944–45	----------	----------	1,800	400	400	----------	2,600

*Fertilizer year begins Aug. 1; ends July 31.
Source: Ministry of Agriculture and Forestry.

The consequent decline in crop yields is shown for cereals in Table 17. The exception to the general decline noted for rice was due to the preferential allocation of fertilizers to this primary crop by the government.

Reduction in imports, especially of phosphorus rock and potassium salts, and other indirect effects of the war such as shortages of labor and of spare parts in fertilizer plants, were the most important causes for the decline in fertilizer consumption.

Bomb damage to fertilizer plants became a progressively more important factor in the drop in production as the bombing program continued. However, any decrease in consumption from this cause alone could not have occurred sufficiently early to have affected any crop harvested before VJ-day.

Seven synthetic ammonium sulfate plants, representing 60 percent of the prewar production capacity of the existing 15 plants, were hit by bombs with heavy damage to the largest single producer. But here also production had fallen 50 percent before the plants were hit by bombs (Table 18 and Fig. 2). By-product ammonium sulfate plants, normally accounting for less than 10 percent of total ammonium sulfate output, numbered 27 in Japan; but their total destruction would have made little difference in crop yields. Of the seven calcium cyanamide plants actually in operation during the last two years of the war, the two which together produced more than one-fifth of the 1944 supply were damaged by bombs. However, cyanamide

consumption had already dropped one-third before bombs fell on either plant (Table 18). The consumption of other nitrogenous fertilizers also fell off sharply (Table 18, Fig. 2). The drop in organic fertilizers was due in part to diversion of the materials to direct food and feed uses.

Nine of 28 superphosphate plants were damaged by bombs; but the steady drop in phosphorite imports from 1,200,000 tons in 1940 to 200,000 tons in 1944 had accounted for virtual extinction of this industry before any bombs fell on the plants.

As may be noted in Table 20, Japan depended for her potassium fertilizers upon imports of the finished salts, in large measure from Germany. When the war blockade denied Japan these salts, attempts to produce substitutes domestically fell far short of the mark.

The losses caused by bomb damage to fertilizer plants were a significant factor in affecting the crops harvested in the fall of 1945, but had no important repercussions on the crop yields of the principal foods in Japan until after the hostilities. The effect on the crops harvested in 1945 and subsequent years, however, will be a vital factor in determining the rate of postwar recovery of Japan's food economy. In consequence, the nutritional status of the Japanese people will long bear the mark of the destruction by bombs of fertilizer plants in the Home Islands.

Food imports—Japan's prewar domestic food economy required substantial imports to achieve a balance with the national demand for even a minimal diet. This position steadily grew worse as imports were restricted by blockade and by ship sinkings during the course of the war. Even the attempt to maintain food imports by giving them a shipping priority second only to coal failed to stop the downward plunge. The position had deteriorated to such an extent that in April 1945 virtually all the small remaining shipping capacity was devoted to the import of food (soybeans were given first priority) and salt, to the sacrifice of the small quantity of industrial raw materials still obtainable. The final report of the Transportation Division of the Survey discusses imports in detail and concludes that despite the July 1945 ten percent cut in rations the loss of oversea food supplies would have proved decisive.

On an approximate caloric basis prewar Japan depended on the mainland of Asia and other sources for 19 percent of her food supply. The principal commodities contributing to the 19 percent were rice, wheat, soybeans, other grains, beans and sugar. The degree of Japan's dependence on outside sources for these important foods during the war years is given on a caloric basis in Table 21 with the average for the 1931–40 period for comparison.

TABLE 21.—*Principal food imports of Japan 1931–40 average; 1941–45 annually*

[Percent of total calories of item indicated]

Commodity	Percent					
	1931–40 average	1941	1942	1943	1944	1945
Rice	17	22	19	10	8	3
Wheat	21	1	1	1	0	0
Soybeans	67	72	68	66	73	71
Sugar	84	82	83	79	77	56
Other grains and beans	37	52	34	24	46	35
All foods, weighted mean	19	20	18	12	13	5

Compiled from data furnished by Ministry of Agriculture and Forestry.

It is apparent from this table that the decline in the average total supply of calories shown in Table 33 and Figure 9 was due in significant measure to the dwindling of imported calories. Analysis of the contribution of imports to the supplies of nutritive elements other than calories indicates the values shown in Table 22.

TABLE 22.—*Contribution of imports to nutrient supplies Japan, 1941–45*

[Percent of respective year's available total]

Nutrient	1941	1942	1943	1944	1945
Calories	20	18	12	13	5
Protein	15	14	10	10	9
Fat	12	14	12	15	15
Carbohydrate	22	19	12	9	3
Calcium	10	10	7	8	8
Vitamin A	0	0	0	0	0
Ascorbic acid	0	0	0	0	0
Thiamine	14	12	8	8	6
Riboflavin	10	8	6	7	7
Niacin	11	10	6	5	4

[Percent of 1941 available total]

Nutrient	1941	1942	1943	1944	1945
Calories	20	19	12	13	4
Protein	15	14	9	9	7
Fat	12	13	11	12	11
Carbohydrate	22	20	12	9	3
Calcium	10	10	8	8	8
Vitamin A	0	0	0	0	0
Ascorbic acid	0	0	0	0	0
Thiamine	14	13	8	9	5
Riboflavin	10	8	5	7	5
Niacin	11	10	6	5	3

As might have been predicted, the table shows that the supplies of vitamin A and ascorbic acid were not affected by imports because the supplies of foods which were the principal sources of these nutrients were maintained by domestic production. The supply of animal protein (provided almost entirely by marine products) was little affected, due to the comparatively small imports of fish. The imports of other high quality protein were maintained at a rather steady level due to the priority given imports of soybeans. By comparison of corresponding figures in the two parts of the table it is evident that in most instances the percentage contribution by imports to the supply of a nutrient deteriorated more precipitously than the total supply of that nutrient. On this basis it may be said that the decline in imports of food commodities was an outstanding cause of the deteriorating supply of nutrients during the war. Figure 5 illustrates the comparative rates of diminution in the supply of various nutrients. The tendency toward recovery noted for 1944 may have been due to an increase in the priority assigned to foods among the imports.

Bomb damage to food stocks—One of the factors that contributed to the restriction in the food supply available to the civilian population in Japan during 1945 was the destruction of foods in storage by American bombs. While there is no evidence to indicate that food was ever a target of strategic bombing, the raids on urban areas and "spill-overs" during raids caused incidental losses of food stocks. The principal damage was inflicted between February and 31 July 1945. As might have been predicted, the losses were concentrated in the cities which had been the most heavily bombed.

Of the so-called staple foods, comprising rice, flour, biscuits, wheat and other grains, a total of 129,820 metric tons were reported destroyed as shown in Table 23.

An additional 91,876 metric tons of "supplementary" food products were destroyed due to bombing (Table 23). The omission of many important categories of food from the table, such as fruits and vegetables, indicates that many important losses have not been calculated. The figures given in Table 23 were calculated from incomplete data furnished the Survey by the Ministry of Agriculture. They represent stocks which were in the hands of the government, of official local food corporations and of food control companies, and were warehoused throughout the Home Islands. More inclusive figures obtained by the Medical Division directly from prefectural food offices indicate that actual losses due to bombs may have been several times as large as the quantities included in the Ministry reports. In addition to the 221,591 metric tons reported in Table 23, large but indeterminate quantities of foodstuffs in distribution channels and outlets and in homes were also destroyed. It is interesting to note that the quantity of staple foods known to have been destroyed by bombs was slightly larger than the total amount diverted from consumption by the 10 percent reduction in the ration from July to November 1945. The decline in the population of Japan due to air-raid casualties did not offset more than an insignificant fraction of the loss in stocks.

The losses of foods were estimated to have been 50 percent due to total destruction by burning and 50 percent to heat damage sufficient to render the products inedible. This deviates from the findings of the Survey in Germany where it was consistently reported that incendiary bombs which fell into grain stocks were extinguished by exclusion from the air. In Germany, also, it was estimated that for the much more prolonged and intensive bombing of that country only 350,000 metric tons of foods were destroyed in all.

Emergency rice stocks—In an attempt to avert the possibility of local shortages resulting from dislocations in the food supply due to bombing, the Japanese established emergency stocks of rice at 25 points in the Home Islands. This program could not have been considered an adequate safety measure because the stocks were equal to only an extremely small fraction of the annual consumption. When the atomic bombing of Hiroshima made emergency feeding necessary, the local contingency stocks proved to be grossly inadequate. Every expediency was used in an attempt to provide even a handful of rice per day to the survivors. Here was none of the highly integrated emergency food supply program observed by the Survey in Germany. (The Effects of Bombing on Health and Medical Care in Germany, U. S .Strategic Bombing Survey, Washington, D. C., 30 Octo-

TABLE 23.—*Bomb damage to food stocks in the Home Islands of Japan*

[Metric tons]

Prefecture	Staple foods								Supplementary foods [1]						Supplementary foods [1]—Continued														Total all foods
	Local food corporation stocks				Government control stocks				Total staple foods	Canned foods	Sugar	Meat	Milk for infants		Milk, whole	Butter	Eggs	Beans (except soybeans)	Marine products	Miso [2] factories					Shoyu factories					Total supplementary foods	
	Rice	Biscuits	Flour	Other grains	Rice	Biscuits	Wheat barley	Other grains					Condensed	Powdered						Soybeans	Salt	Rice	Barley or rye	Miso	Soybeans	Salt	Wheat	Moromi [3]	Shoyu	
Hokkaido	30				339		7	555	931	102			.44	1.00																255.44	1,186.44
Aomori	264	80	7		82		2	44	479	181				3.78	16.9					27	6	17		289	36	12	2	79	23	2,703.68	3,182.68
Iwate	16				136			143	295					3.24	5.6					6	3	9		137	51	16	56	2,039	1	303.84	598.84
Miyagi					38		4	305	347				2.85	0.66	41.5					33	3	53		310	12	2	9	127	2	695.01	1,042.01
Akita														2.16												7	23	200	9	2.16	2.16
Yamagata																															
Fukushima					10				10					3.24	11.3										1	1	2	7	3	28.54	38.54
Ibaraki	72	67	12	795	259		196		1,401				1.90	2.16	26.4					25	4	15		312	138	25	124	476	53	1,202.46	2,603.46
Tochigi	25			181	172		528	200	1,106				5.66	13.78	15.0					59	2	20	42	93						250.44	1,356.44
Gumma	6			343	73		354		776					3.24	15.0					9	3		17	57	12	2	10	83	1	212.24	988.24
Saitama				54	427		731	660	1,872											1			1	83	2	10	5	350	23	475.00	2,347.00
Chiba	113	113		483	2,724		397	314	4,144	644	148			5.40	47.2					9	30	18		252	551	343	713	7,004	263	10,027.60	14,171.60
Tokyo	9,532	124	1,037	5,249	6,001	622	163	1,111	23,839	130		19		74.60	943.3		9	12	207	1,319	96	606	8	2,856	24	76	13	1,480	186	8,058.90	31,897.90
Kanagawa	850	8		23	809	500	764	1,178	4,132	29			5.70	3.24	358.4	22.5	5	18	174	202	52	13	6	1,448	147	153	117	3,124	193	6,070.84	10,202.84
Niigata	95				254		6	2,500	2,855					0.86	11.3					371	50	3		368	61	44	64	305	12	1,290.16	4,145.16
Toyama	29	51		765	332				1,177				0.95	2.16	15.0					79	30	5		123	49	21	56	1,672	117	2,170.11	3,347.11
Ishikawa																															
Fukui					20				20				0.63	1.57	18.8					3	15	8		22	57	21	95	743	20	1,005.00	1,025.00
Yamanashi	153	2		62	1,147	6	130	50	1,550				1.52	2.49	15.0	0.3				8	21	3	46	111	14	46	15	1,870	94	2,247.31	3,797.31
Nagano							3	8	11				2.94	0.27																3.21	14.21
Gifu	20				200			100	320					4.53	24.5					38	5	1		56	4	9	1	578	139	860.03	1,180.03
Shizuoka	60		474	237	272		2,069	1,466	4,578	1,391				4.32	84.9	0.2				82	6	33	16	556	68	3	170	1,362	80	3,856.42	8,434.42
Aichi	15,260		24	23	591	20		2,912	18,830	42	624		9.50	10.80	226.4			60	26	99	38	13		695	239	148		1,881	193	4,304.70	23,134.70
Mie	30				318		57	2	407		22				37.7					16	6	4		63	579	289	36	2,481	102	3,635.70	4,042.70
Shiga																															
Kyoto																															
Osaka	1,810	27	100	101	2,412	266	1,635	1,859	8,210	663	570	74		21.60	339.6	135.0	20			132	50	53	28	2,525	81	126	110	2,260	104	7,292.20	15,502.20
Hyogo	155	11	89		12,034	100	12,988	1,000	26,377	1,774	41	27	15.00	169.00	226.4	5.7		[4] 8,764	1,054	36	14	14	7	977	13	115	50	1,059	258	14,619.10	40,996.10
Nara														0.54																0.54	0.54
Wakayama													0.19	5.94	33.9					17	6	7	4	63	25	2	14	112	1	291.03	291.03
Tottori																															
Shimane																½															
Okayama	305				500		300		1,105				6.84	0.11	30.1					259	3	25	26	331	38	19	34	442	33	1,247.05	2,352.05
Hiroshima	80				758	20	200	300	1,358	1,023			3.80	6.48	67.9					44	17	35	13	251	94	22	49	1,926	90	3,642.18	5,000.18
Yamaguchi	25				200			5,000	5,225		402		9.62	0.21				180		49	1	4	17	60	8	43	21	253	338	1,385.83	6,610.83
Tokushima	188	21	223	162	136		529	299	1,558					1.08	16.9					9	18	25	33	292	32	8	18	891	41	1,384.98	2,942.98
Kagawa	125		2	477	288		75		967				0.12	0.16	16.9					1	4	5	1	97	3	12	21		54	215.18	1,182.18
Ehime	195		31		77		835		1,138					0.54	22.6					12	11	5	4	49	67	63	157	1,630		2,021.14	3,159.14
Kochi					90		57		147						18.8					14	6	14	6	131	12	6	23	46	51	327.80	474.80
Fukuoka					1,030	200	1,340	10,000	12,540	1,735	472			10.80	113.0		3			117	4	11	51	212	111	158	161	809	30	3,997.80	16,537.80
Saga					9		30		39																			6	1	7.00	46.00
Nagasaki	28	113		130	734			26	1,081					4.32	39.6					16	3	3	8	110	113	119	111	2,984	181	3,691.92	4,772.92
Kumamoto	40				401				441					1.08	33.9	0.4				72	7	17	30	243	30	12	65	338	64	913.38	1,354.38
Oita															11.3										9	18	15	10	7	70.30	70.30
Miyazaki															22.6										62	22	21	127	7	261.60	261.60
Kagoshima	54				500				554				0.95	3.24	33.9					6	2	2	4	22	102	43	64	422	38	743.09	1,297.09
Total	29,560	617	1,999	9,135	33,343	1,734	24,400	30,032	129,820	7,714	2,279	120	68.61	368.60	2,941.6	164.1	37	9,034	1,461	3,170	516	1,041	368	13,194	2,845	2,016	2,445	39,176	2,812	91,770.91	221,590.91

[1] In addition, 3,752 tons tea were destroyed by bombs in Shizuoka prefecture; tea losses in other prefectures not available.
[2] Losses in Miso (soybean paste) plants for 14 prefectures not available.
[3] Shoyu (soybean sauce) mash in process of fermentation.
[4] Includes 8,734 tons soybeans.
Source: Ministry of Agriculture and Forestry, Hyogo Ken Food Office, and Osaka Fu Food Office.

ber 1945.)

Effects of bombing on food processing industries—While the processing industries constitute a comparatively unimportant sector in the Japanese food economy compared to United States experience, food products accounted for 9 percent of the yen value of the total factory output of Japan in 1938. Industries of recent development or those requiring an advanced state of technology, such as quick-freezing, do not exist at all. Among the industries based more on empirical practice, however, the manufacture of various fermented products, the milling of cereal grains, sugar refining and confectionery manufacture represented together more than 65 percent of the total yen value of all food processing in Japan. The Japanese canning and bottling industry, producing less than 6 percent of processed food products in Japan, was the sixth largest in the world. With the exception of very few plants, these industries depended upon little modern equipment and even in the important Kobe-Osaka area were small and greatly dispersed. The only point at which attack against the food processing industry in Japan would have been practicable was in its supply of raw materials. The supply of raw foods is discussed over-all in other sections; the supply of other raw materials is discussed below as it may be relevant to specific industries. On virtually all counts, therefore, the industries themselves would have provided poor targets to bomb and, in fact, were never selected as such. Any damage caused by bombs must be considered as having been incidental during attacks on other targets.

The consumption of canned foods by the average Japanese civilian was vanishingly small, but production maintained an average of over 9 million cases annually between 1938 and 1940—much of it for export. While 13 canneries of the original 310 were destroyed and 3 were damaged by bombs, production had already fallen to 2 million cases in 1944. Since Hokkaido was the only section of the home islands with a surplus in agricultural production, even on the prewar basis of consumption, it is apparent that domestic production alone could not have supported an extensive canning industry. Consequently, it may be concluded that the wartime deterioration of the total food supply was responsible for at least part of the decline in the production of canned foods. Canning had also suffered from a shortage of packaging materials, such as tinplate, beginning in 1940. Although glass packs were introduced, production capacity for this type was small. The deficient coal supply, the rise in prices of raw foods and irregularity of transport all contributed to the decline of canning as well as other food industries.

Detailed statistics on the cold storage and freezing industry are not available. The destruction of 90 percent of Osaka's 40,000-ton cold-storage capacity is cited as an example of the effects of bombing incidental to extensive urban area raids on this industry.

In 1945 the estimated milk production decreased to approximately 56 percent of the 1944 total due to a decline in imports of high grade fodder and the diversion of domestic fodders to direct human consumption. For the same reason condensed milk production decreased to less than 50 percent, powdered white milk to 50 percent and butter to 60 percent of their 1943 totals. The normal production of cheese (only 400,000 pounds per year) virtually disappeared, thus eliminating one of the smaller sources of the critical animal proteins. Six of the dairy processing plants in Japan were totally destroyed by bombs in July and August 1945. The total production capacities of the dairy processing industries at the war's end were: condensed milk—15 percent; powdered milk—45 percent; and butter—30 percent of the respective original capacities.

Damage by bombs to 31 flour mills caused a loss in monthly capacity of 31,864 barrels, which was equivalent to 36 percent of the total Japanese capacity in 1944. Hyogo and Osaka prefectures lost about 80 percent of their respective flour milling capacities as their disproportionate shares of the damage.

Approximately 85 percent of Japan's raw sugar was supplied from Formosa. Of the factories producing this sugar 70 percent were damaged in some measure by air raids against that island. Due in part to the factory damage and in part to the reduction in the flow of sugar imposed by the blockade, all sugar refineries in the Home Islands were shut down by early 1944, long before any bombs were dropped there. The drastic effects of this chain of events may be seen in the decline in the sugar con-

CONTRIBUTION OF IMPORTS TO NUTRIENT SUPPLIES

JAPAN, 1941-1945

(PERCENT OF 1941 AVAILABLE TOTAL)

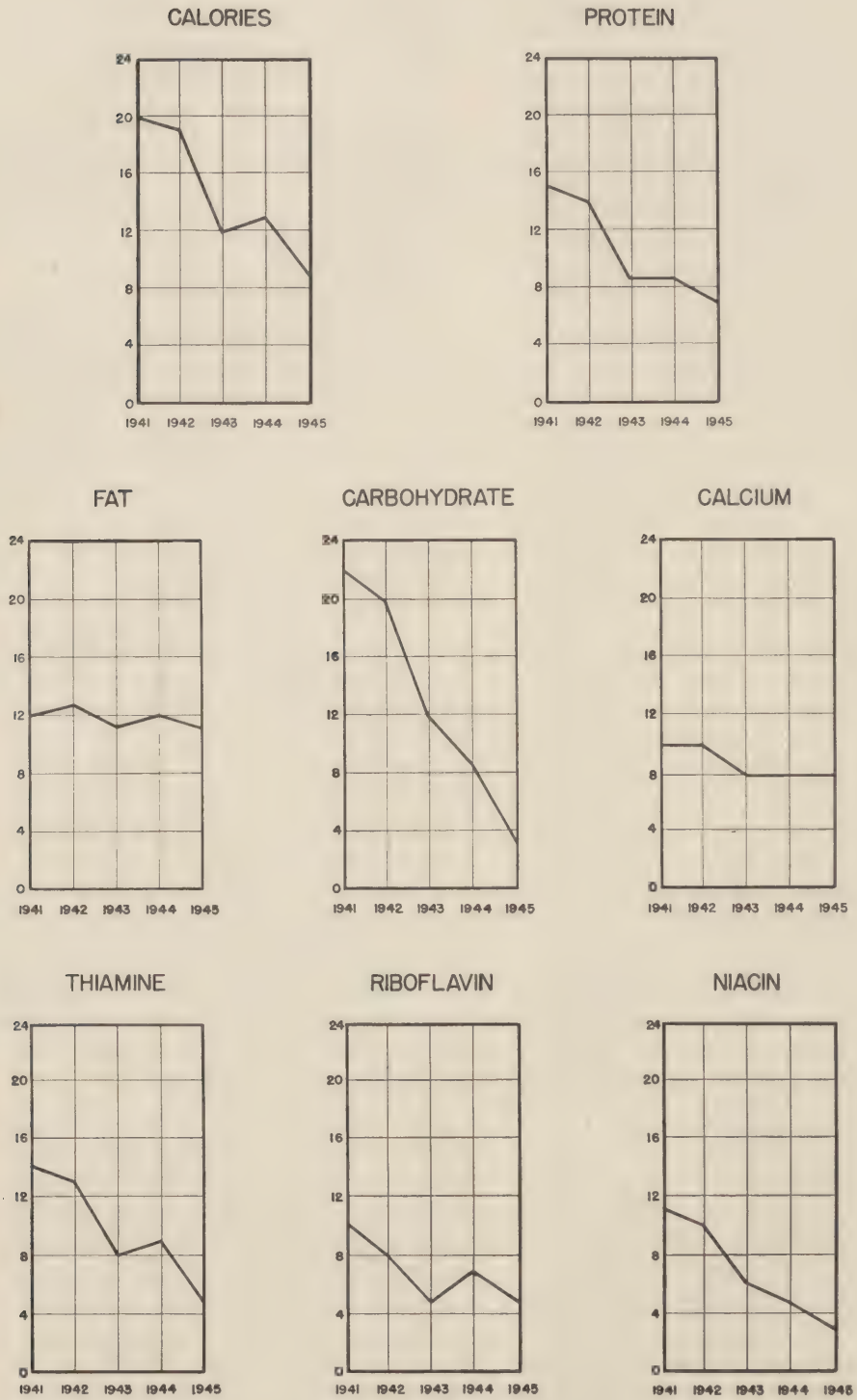


FIGURE 5

sumption of Japanese civilians (Table 28 and Figure 8).

Bomb damage to factories caused a drop of 43 percent in the production capacity of the confectionery industry.

Soybean fermentation products constitute an important segment of the Japanese dietary. While in themselves they contribute comparatively little to the supplies of nutrients (Appendix B–1 to B–5), they affect the consumer acceptability of other foods to a considerable degree. In addition, the effect of the seriously attenuated supply of these items could not have aided in the maintenance of civilian morale. Of the 5,600 factories producing Miso (soybean paste) 404 were destroyed by bombs. While the damage to Shoyu (soybean sauce) factories reduced the total production capacity only 5 percent over all Japan the physical damage was widely dispersed. Three hundred and fourteen of these factories were destroyed and two of Japan's three largest were heavily damaged. Due to the concentration of food processing industries in the Osaka-Kobe area and the comparatively large bomb tonnage dropped there, the reduction in total production capacity of Miso factories in Hyogo prefecture was 25 percent; in Osaka prefecture, 20 percent of the prebomb figures. For Shoyu factories comparable losses were: Hyogo—20 percent; Osaka—40 percent. A further and important effect on the Miso and Shoyu industries was the destruction of containers. In Hyogo prefecture alone 60,000 Miso containers and 15,000 Shoyu containers were destroyed by fires caused by air raids.

The manufacture of substitutes for Shoyu, Aji-no-moto (monosodium glutamate) and Amino-san (an acid hydrolysate of wheat gluten and soybeans), both of which had been developed before the war, required more machinery and technological control. Since the effective rate of output per unit of plant area was higher for these substitutes than for Shoyu, any plant damage would have had a proportionately greater effect on supply levels. Six of the twelve Home Island sodium glutamate factories were damaged by bombs. Of the 51 factories producing Amino-san, 11 were affected, 6 of the 11 being totally destroyed.

Forty-seven factories producing and refining edible oils and fats, constituting 14 percent of the number of factories and 40 percent of the production capacity available in 1944, were lost through bomb damage. This aided to a large degree in reducing the consumption of these calorie-rich foods in the Home Islands. Even the diversion of oil seeds and oil cakes from industrial ,fertilizer and fodder uses to direct consumption as foods did not materially impede the decline.

Effects of bombing on food distribution—Due to the inadequacies of land transportation, food distribution in the Home Islands depended extensively on inter-island and coastwise shipping. When ship sinkings and blockade made long hauls by rail mandatory, the high priority of foods among imports was carried over to the railroads. Consequently, the ton-kilometer figures on long-haul rail distribution were maintained at the expense of lower priority items. When the conservation of gasoline was decreed by the government, effective 6 December 1941, it limited the length of short hauls of nonwar materials. This decree limited truck transportation of food to a 50-kilometer radius of the point of origin, thus increasing the load on other forms of transport.

The collection and distribution of food at rail terminals suffered badly when the fire bombing of urban areas destroyed freight handling facilities or impeded their operation. This effect was heightened when large numbers of wooden containers used in food distribution and vehicles used in local transport were destroyed during incendiary raids on urban areas.

Food Rationing System

This section is an exposition of food rationing in Japan insofar as it affected the supply of commodities available to civilians. In that sense it extends the previous section from the level of the national economy to that of the individual consumer. It also introduces the following section on per capita consumption levels. The ration allowances failed to provide adequate quantities of food for continued health and work even though attempts were made to adjust them to the physiological requirements of the individual.

The staple foods—Beginning in April 1941 the rationing of so-called "staple" foods was instituted by decree for the six principal cities

TABLE 24.—*Wartime ration allowances of staple foods*[1] *Japan, 1941–45*

[grams per person per day]

Age	Work classification	Sex	April 1941[2] (February 1942)	Special supplements to the ration					May 1945			Aug. 11, 1945 (July 11, 1945)[7]		
				December 1941[3]	March 1942	December 1942[4]	April 1944	June 1944	Household[6]	Factory supplement[5]	Total[5]	Household[5]	Factory supplement	Total[5]
1–2		All	120					[8] 40	120		120	108		108
3–5		All	120		50				170		170	153		153
6–10		All	200		60		[9] 100		250(280)		250(280)	225(252)		225(252)
11–15		All			60				360(400)		360(400)	324(360)		324(360)
16–60	General	All	[10] 330		[11] 60				330		330	297		297
	Moderate	Male	[10] 390						330	60–200	390–530	297	56–280	353–577
		Female	[10] 350						330	20–160	350–490	297	18–144	315–441
	Heavy	Male	[10] 570	140		140			400	170–330	570–730	360	153–297	513–657
		Female	[10] 420	140		140			330	90–230	420–560	297	81–207	378–504
More than 60	General	All	300						300		300	270		270
	Moderate	Male	350						300	50–190	350–490	270	45–171	315–441
		Female	320						300	20–160	320–460	270	18–144	288–414
	Heavy	Male	480	140		140			300	180–320	480–620	270	162–288	432–558
		Female	380	140		140			300	80–290	380–590	270	72–261	342–531
Any		Pregnant women			60				[12] 50		50	45		45

[1] For comparison: 1937–41 per capita average—450 gm.; 1942–45 average—311 gm.; average after 10 percent reduction in 1945—280 gm.
[2] Rationing began April 1941 in six principal cities only; extended to entire country February 1942.
[3] Special addition for shipbuilders, stevedores, colliers, miners, iron and steel workers.
[4] Special addition for charcoal burners and lumbermen.
[5] Figures in parenthesis apply to six principal cities only.
[6] Size of allowance depended on type of work.
[7] Ten percent universal reduction effective in six principal cities Aug. 11; all other prefectures July 11.
[8] In all prefectures except six principal cities.
[9] School lunches in six principal cities only.
[10] Also includes 11–15 year group.
[11] Up to 20 years.
[12] Special addition to basic ration.

of Japan (Tokyo, Yokohama, Osaka, Kobe, Kyoto, and Nagoya). This meant that for the first time the consumption of the mainstay of the Japanese diet, rice, by many millions of non-food producers, was directly controlled by the government at the point of purchase. In February 1942 staple food rationing was extended to all prefectures and included even self-suppliers.

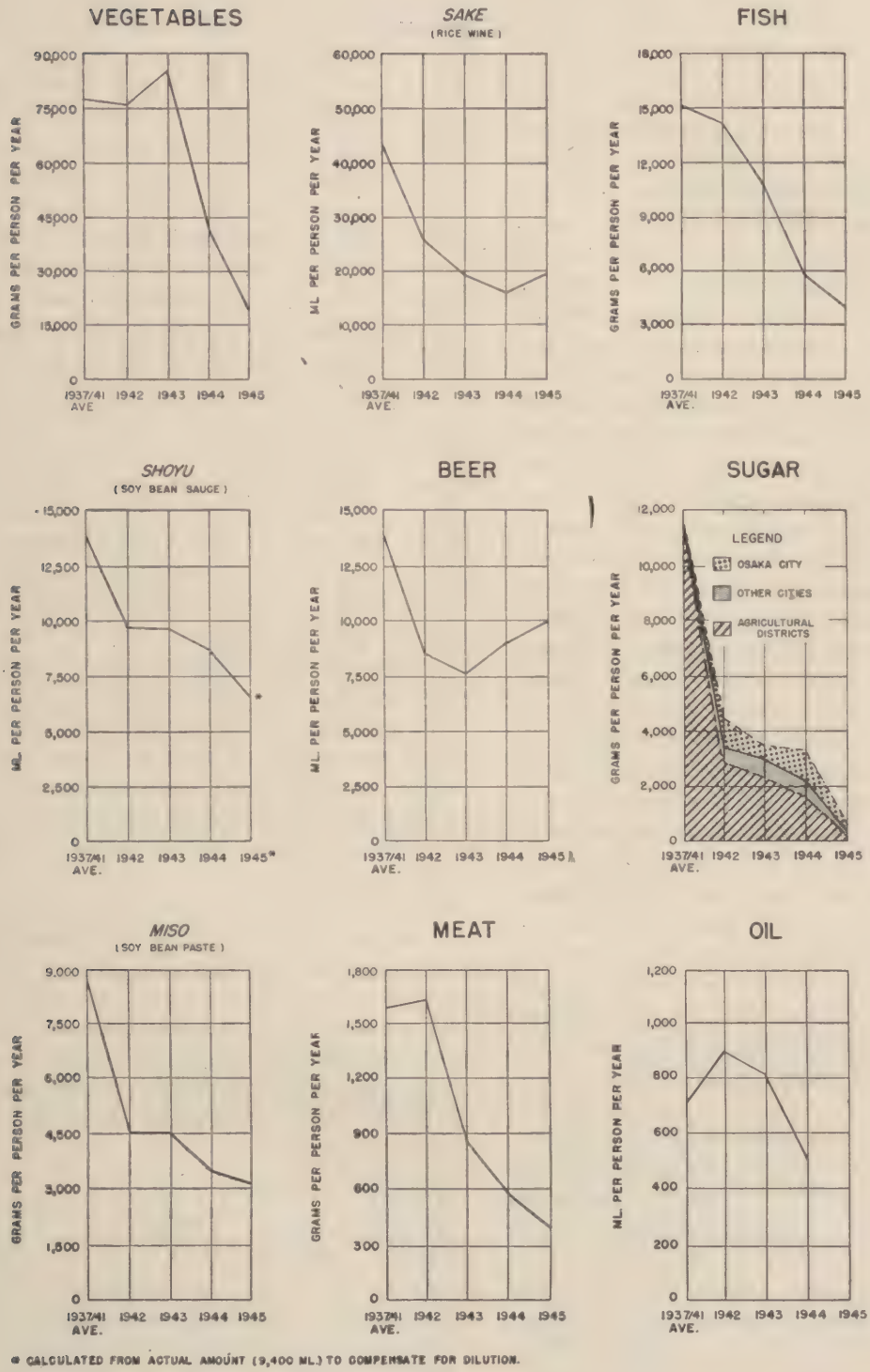
The ration allowances were initially set at values approaching prewar experience and were based on estimated physiological need for calories according to age, sex and degree of activity. The basic allowances for the various groups, with supplements, and changes, are given in Table 24.

It may be noted from this table that the original schedule of allowances required changes to compensate the inequities which arose for certain special groups. The first of these was a special supplement for certain very heavy workers for whom the original allowance was seriously deficient. This supplement to workers in specific occupations was extended to a few more categories later as the need became apparent. Special additions were made to the rations for children by way of school lunches and for pregnant women in an attempt to meet their special requirements.

In May 1945 the curtailed food position made necessary a reorganization of the ration system. Under the new plan the sizes of allowances were maintained, but the supplements for industrial workers were distributed at the place of work only, thus creating an incentive among the workers themselves to reduce absenteeism. A net saving in total consumption may also have accrued from the more ramified breakdown of occupation categories which allowed a finer subdivision of the supplements according to the degree of activity. Cognizance was also taken of the disadvantage under which the workers in large cities labored in obtaining food outside the ration, compared to those in the less highly urbanized areas.

Maintenance of the size of the ration allowances had been pledged to the people by the government in a bid to uphold morale. This pledge was made good until near the end of the war, but only by dint of adulterating the basic rice allowance with wheat, barley and other grains, potatoes and soybeans. The degree of substitution at any given time varied with location depending upon the size of local stocks. As the war progressed and the supply position deteriorated the extent of adulteration gradually increased to compensate for the diminishing supply of rice as is shown in Table 25. While adulteration of the staple ration is calculated to have risen from 2 percent in 1942 to almost 18 percent in 1945 on the basis of national sup-

SUPPLEMENTARY FOODS
DISTRIBUTED THROUGH OFFICIAL CHANNELS
OSAKA PREFECTURE, JAPAN
1937/41-1945



* CALCULATED FROM ACTUAL AMOUNT (9,400 ML.) TO COMPENSATE FOR DILUTION.

FIGURE 6

TABLE 25.—*Foods substituted for rice in the staple ration Japan, 1942–45*

[Metric tons]

Food	1942	1943	1944	1945
Wheat, barley and naked barley	393, 333	632, 500	916, 433	1, 241, 667
Potatoes and other grains		102, 000	915, 833	1, 023, 333
Total	393, 333	734, 500	1, 832, 266	2, 265, 000
Percent of total staple ration	2. 0	5. 6	13. 9	17. 6

Source: Ministry of Agriculture and Forestry.

ply, local conditions varied widely from these over-all percentages. For example, according to a detailed report of the Osaka Prefecture Food Office to the Medical Division, the local substitution of other grains, potatoes and soybeans there varied from about 20 percent in 1942 to 40 percent in 1945. In addition, the adulteration of wheat flour with potato starch increased as the food supply contracted. The effects of substituting other foods for rice and potato starch for wheat flour on the nutritional quality of the ration will be discussed in a later section. Finally, the pledge to maintain the size of the ration could not be upheld even by wholesale substitution and a 10 percent reduction in allowances was imposed. It became effective on 11 August 1945 in the six principal cities and on 11 July in all other parts of Japan and applied uniformly to all basic and supplementary allowances.

The rationing of staple foods, in recapitulation, was instituted with allowances such that the quantity of rice legally available to the average consumer was almost 9 percent less than the 1937–41 figure. The reduction innate in the substitution for rice of other foods may be considered as a factor of importance in respect to food acceptability and the state of civilian morale. When the government's pledge to maintain the size of the ration was abandoned in the 10-percent cut of July and August 1945 the entire food economy was bordering on collapse.

The supplementary foods—All foods other than those designated "staple" were considered "supplementary" and the control of consumption of these foods was sometimes administered through a loose form of rationing system. Except in the cases of Miso (soybean paste) and Shoyu (soybean sauce) a better term for this control would be "apportioning system." The distribution of all foods was brought under government control during the period June 1940 to February 1942, either directly in the Ministry of Agriculture and comparable prefectural and municipal offices, or indirectly through the various commodity control companies. Except for the staples, Miso and Shoyu, however, the size of the ration allowance was not fixed and fluctuated in direct proportion to the availability of local supplies.

The rationing of Miso and Shoyu began in December 1942 largely to conserve the soybeans from which these widely sought commodities were derived. As has been noted before the bulk of the soybeans used in Japan was imported (largely from Manchuria). In establishing the sizes of the ration allowances of these items an attempt was made to meet the local traditional dietary habits in the various parts of the country. These allowances by prefecture are shown in Table 26. They remained constant until about the time of the reduction in the staple ration in July 1945. In June a general change in the allowance schedule was made which, for Miso in a few cases, caused an increase, but in most prefectures a decrease was invoked. In all cases for Shoyu not only a decrease in size of the ration was imposed, but dilution of the nitrogen content from 1.0 to 0.7 percent was ordered, thus reducing the nutritive value by 30 percent.

As an example of the general trend in the size of the rations of other supplementary foods during the war the quantities distributed through official channels in Osaka prefecture per capita per year are presented in Table 27 and Figure 6. Even in the case of fish, of which Osaka had always been a large producer, the size of the ration diminished consistently in most cases as the war continued. The severe curtailment in the supplies of vegetables was also notable. The situation was comparable in other prefectures, including those like Kyoto which had been subjected to minor bombing effort, according to reports furnished the Survey.

Commodity Consumption Levels

In assessing the total supply of food commodities available for human consumption many factors were considered. For each war year the total amount of foods produced in the Home Islands (including that consumed by the producers) was added, by individual com-

TABLE 26.—*Miso and Shoyu ration allowances by prefecture, 1942–45*

[per capita per month]

Prefecture	Miso allowance (grams)		Shoyu allowance (milliliters)	
	December 1942 to June 1945	After June 1945	December 1942 to June 1945	After June 1945*
Hokkaido	1,020	900	540	252
Aomori	1,020	900	540	252
Iwate	1,020	900	540	252
Miyagi	1,020	900	540	252
Akita	1,020	900	540	252
Yamagata	1,020	900	540	252
Fukushima	1,020	900	540	252
Ibaraki	675	675	650	----
Tochigi	675	900	650	252
Gumma	675	450	650	----
Saitama	675	900	650	252
Chiba	675	450	650	466
Tokyo	675	675	650	330
Kanagawa	675	675	650	330
Niigata	1,020	900	540	252
Toyama	675	900	650	252
Ishikawa	375	675	830	330
Fukui	375	675	830	330
Yamanashi	375	450	830	466
Nagano	1,020	900	540	252
Gifu	675	675	650	330
Shizuoka	675	675	650	330
Aichi	675	675	650	330
Mie	675	675	650	330
Shiga	375	450	830	466
Kyoto	375	450	830	466
Osaka	375	450	830	466
Hyogo	375	450	830	466
Nara	375	450	830	466
Wakayama	375	450	830	466
Tottori	375	450	830	466
Shimane	375	450	830	466
Okayama	375	450	830	466
Hiroshima	375	450	830	466
Yamaguchi	375	450	830	466
Tokushima	375	450	830	466
Kagawa	375	450	830	466
Ehime	375	450	830	466
Kochi	375	450	830	466
Fukuoka	675	675	650	330
Saga	675	675	650	330
Nagasaki	675	675	650	330
Kumamoto	675	675	650	330
Oita	675	675	650	330
Miyazaki	675	900	650	252
Kagoshima	675	900	650	252

*The size of the ration in each case was actually larger than the figure given here. However, the dilution of Shoyu from 1.0 percent nitrogen content to 0.7 percent, authorized at the same time the size of the ration was changed, required a 30 percent reduction to compensate the published figures to a basis uniform with the earlier ration allotments.

TABLE 27.—*Supplementary foods distributed through official channels Osaka prefecture, Japan 1937–45*

[grams per person per year]

Food	Average 1937–41	1942	1943	1944	[1] 1945
Vegetables	77,745	77,015	83,585	43,290	19,740
Sake (milliliters)	43,680	25,680	19,200	15,600	19,200
Fish	16,670	14,235	11,096	5,876	4,116
Shoyu (milliliters)	14,000	9,700	9,700	8,700	[2] 6,580
Beer (milliliters)	14,000	8,500	7,700	9,000	10,000
Sugar:					
Osaka city	10,800	4,320	3,780	2,775	360
Other cities	10,800	3,600	3,060	2,235	300
Agricultural districts	10,800	2,880	2,340	1,695	240
Miso	8,800	4,500	4,500	3,450	3,150
Meat	1,595	1,642	865	591	398
Oil (milliliters)	[3] 720	900	810	500	NA

[1] Estimated from distribution to 1 July 1945.
[2] In June 1945 the nitrogen content of Shoyu was dropped by law from 1.0 to 0.7 percent as a means of extending the restricted supply. In consequence, the figure given was derived from the actual amount (9,400) by calculation from the nitrogen content for comparison with the previous years.
[3] 1941 only.
NA—Not available.
Source: Food Control Division, Osaka Prefectural Government.

modity, to the total amount imported with corrections for changes in hold-over stocks to obtain the whole amount in supply. The additional, but unknown, quantity of foods produced in "victory" gardens could not be taken into account. The fact should be borne in mind in later discussion, especially in respect to vegetables, because such gardens were widely cultivated. Accurate estimates of total area involved and its productivity would have been virtually impossible because individual plots were usually minute and scattered everywhere, even on city streets where sidewalk paving had been removed. The total quantity in supply diminished by the amounts used for feed, seed and industrial purposes, by the military and a reasonable margin for waste, was the total quantity available for human consumption. This total was divided by the total civilian population as estimated for each year to derive the amount available per capita per day. Up to this point the data furnished the Survey from various Japanese sources, principally the Ministry of Agriculture and Forestry, were evaluated and analyzed in conjunction with the Manpower, Food and Civilian Supplies Division of the Survey. Since this study was intended to be principally a year-by-year comparison of the supply situation over the period of the war certain ultimate refinements of analysis were omitted. However, on a comparative basis the relationships in the supply from year to year are accurate.

Trends in average per capita supply—The per capita supply of all foods (by commodity) available for civilian consumption in Japan for each year between 1941 and 1945, stated in grams per capita per day, are shown in Table 28.

It will be noted from this table that for all major food groups, except potatoes and beans and soybeans, the net change over the period of study was a serious decline. The supply levels of the potato group and the bean and soybean group increased significantly during the war. Except for an initial increase in the supply of rice, vegetables and fruits, all other food declined steadily from the very beginning. The rate of decline for most of these foods was especially rapid in 1944 and 1945. These points are illustrated by Table 29 and Figure 7.

Rice showed a comparatively small rise in

SUPPLIES OF PRINCIPAL FOODS AVAILABLE FOR HUMAN CONSUMPTION

JAPAN, 1941-1945

(PERCENT CHANGE COMPARED WITH 1941)

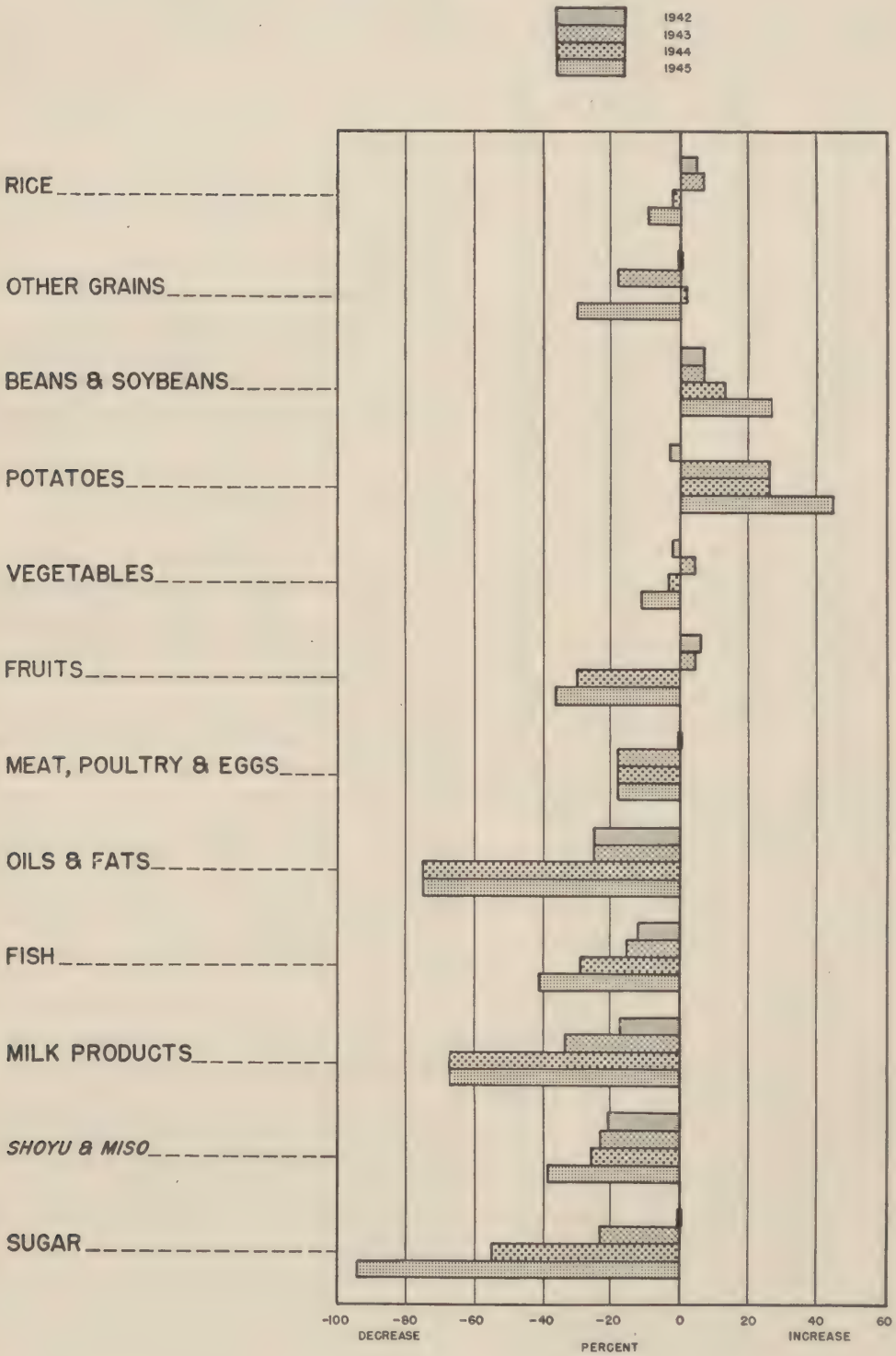


FIGURE 7

TABLE 28.—*Estimated food supplies available for civilian consumption Japan, 1941–45*

[Grams per capita per day]

Item	1941	1942	1943	1944	1945
Rice	337	354	360	330	308
Wheat	36	38	30	38	25
Barley	16	17	14	19	12
Naked barley	23	22	18	22	16
Corn, millet, Kaoliang	8	6	6	6	5
Grains, other, total	83	83	68	85	58
Soybeans	8	10	10	11	13
Other beans	7	6	6	6	6
Beans and soybeans, total	15	16	16	17	19
Potatoes: Sweet	73	67	101	108	115
White	54	56	59	52	68
Potatoes, total	127	123	160	160	183
Vegetables	219	215	228	212	194
Fruits	47	50	49	33	30
Meat (including poultry)	7	7	6	6	5
Eggs	4	4	3	3	4
Meat and eggs, total	11	11	9	9	9
Seaweeds	4	5	5	5	5
Oils and fats	4	3	3	1	1
Butter	0.1	0.1	0.1	0.1	0.1
Fish	119	105	101	85	70
Milk, condensed and powdered	0.6	0.5	0.4	0.2	0.2
Shoyu	41	32	30	27	21
Miso	21	17	18	19	17
Shoyu and miso, total	62	49	48	46	38
Sugar	31	31	24	14	2
Total	1,059.7	1,045.6	1,071.5	997.3	917.3

supply in 1942 and 1943 to a maximum of 7 percent higher than the 1941 level. After this point the loss of imports, despite attempts to maintain domestic production, caused a decline to 9 percent below the 1941 value.

Grains other than rice remained at the 1941 level for one year, fell to 18 percent below the next, recovered in 1944 and were curtailed in 1945 to 30 percent below 1941. The net effect was a serious decline over the war years.

Bean and soybean net availability was increased consistently to 27 percent more than 1941 by increases in imports of soybeans from Manchuria. The level of other beans, which were produced domestically, fell off slightly in the same period.

Potatoes constituted the commodity group which increased most during the war and attained a maximum of 44 percent over 1941 in the last year of the war. The change was due almost entirely to increased production of sweet potatoes in the Home Islands.

Vegetable and fruit production experienced little change between 1941 and 1943, however, the decline in 1944 and 1945 reached 11 and 36

TABLE 29.—*Changes in supplies of principal foods available for civilian consumption Japan, 1941–45*

[percent change compared with 1941]

Item	1942	1943	1944	1945
Rice	5	7	−2	−9
Other grains	0	−18	2	−30
Beans and soybeans	7	7	13	27
Potatoes	−3	26	26	44
Vegetables	−2	4	−3	−11
Fruits	6	4	−30	−36
Meat, poultry and eggs	0	−18	−18	−18
Oils and fats	−25	−25	−75	−75
Fish	−12	−15	−29	−41
Milk products	−17	−33	−67	−67
Shoyu and miso	−21	−23	−26	−39
Sugar	0	−23	−55	−94

percent, respectively, below the 1941 levels. The quantity derived from "victory" gardens could not have offset these losses to any significant extent.

Meat, poultry and egg consumption in Japan has always been very small, the total being much less than the equivalent of one egg per person per day. In 1943 the level of supply dropped 18 percent and remained level at that point for the remainder of the war.

Oils and fats were consumed in minute quantities even before the war, according to Western standards. The decrease in supply of 25 percent from 1941 in the following 2 years and a further decline of 75 percent in 1944 and 1945 was a serious loss in the civilian diet.

Fish was traditionally the most important animal product in the Japanese diet. The drop in the supply level of 12 percent in 1942 was continued at a steady rate to a 41 percent loss in 1945 due to reduced catches.

Milk products found no place in the Japanese diet except for infants and pregnant and nursing women. The decline to the 67 percent reduction in 1944 and 1945 affected only this important segment of the population. Comparison with the level of consumption of these products in the United States (prewar basis) of approximately 330 grams per capita per day indicates that Japan's problem in this respect had existed long before the war.

The immediate drop in the availability of Shoyu and Miso in 1942 continued to a curtailment of 39 percent in 1945 despite all-out efforts to maintain soybean imports. Since Shoyu and Miso are items of invariable daily consumption among the Japanese, it may be concluded that this curtailment of supply had far-reaching, adverse, psychological effects on the civilian population.

SUPPLIES OF PRINCIPAL FOODS AVAILABLE FOR CIVILIAN CONSUMPTION

JAPAN 1941-45

(GRAMS PER CAPITA PER DAY)

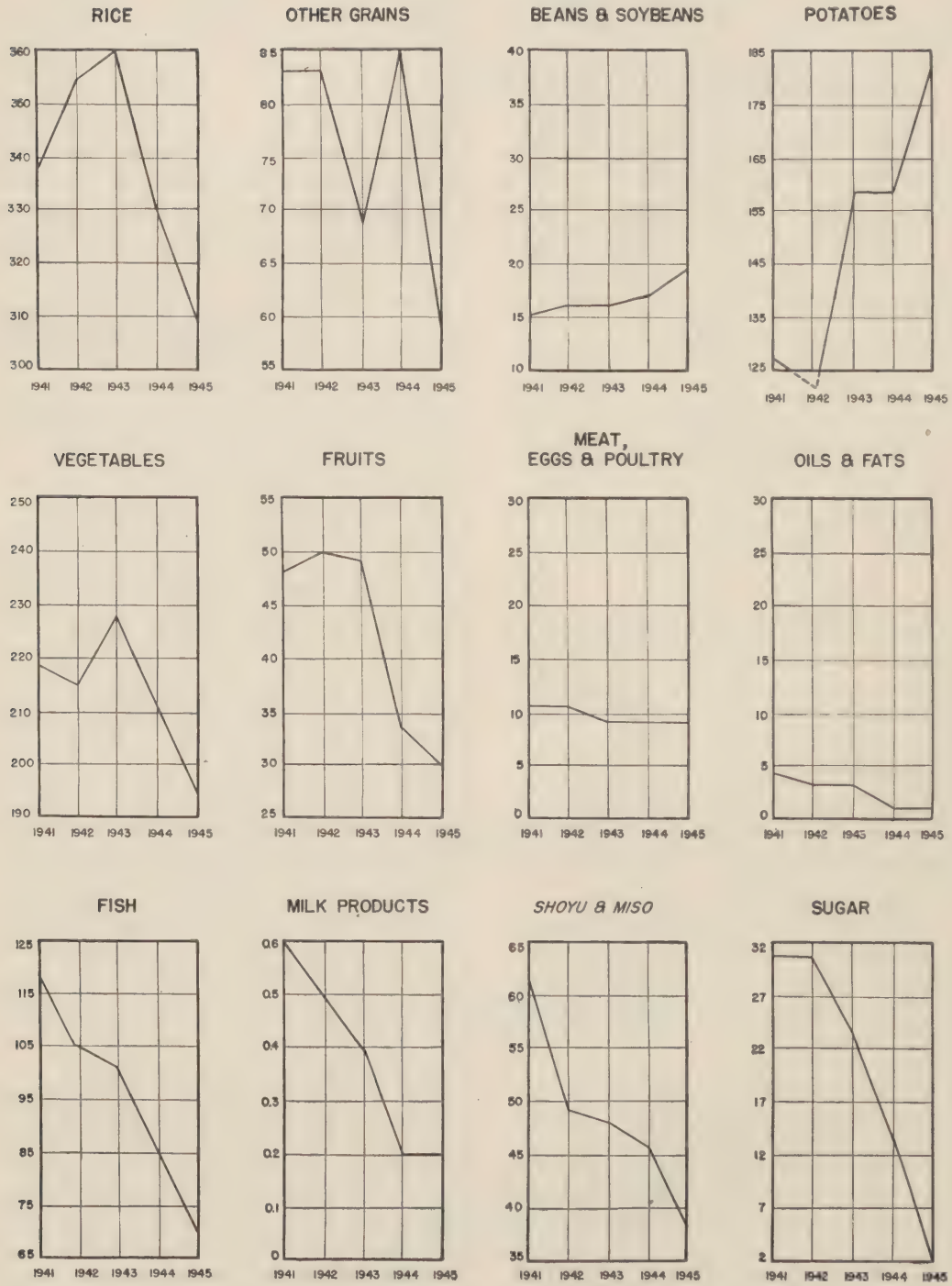


FIGURE 8

Sugar, although consumed at a very low level in Japan compared to the United States, was an important item in the diet. The level of supply declined precipitously, due to loss of imports, to the point of virtual disappearance at 94 percent below the 1941 level in 1945.

The changes which took place year by year in the diet of the Japanese civilian during the war, which are given in Table 28 by individual commodity, are shown by major food groups in Figure 8. These data indicate the trends in availability of food supplies. The graphs show an almost consistent deterioration in the average daily per capita consumption of all food groups except soybeans and potatoes.

The figures presented in this report on per capita supplies of food commodities are not comparable with estimates based on ration allowances or on household surveys. Ration figures for Japan would be seriously low because of the numbers of items which were off the ration. The existence of a large and steadily increasing black market would have increased the errors innate in this method of approach. Household surveys were made in too fragmentary a form by the Japanese prior to the end of the war and circumstances did not permit this omission to be corrected by the Survey with the extremely limited time and number of personnel available.

Deviations from average supply—The discussion in the previous section on the supply of food concerned *average* per capita levels and was based on the assumption that every civilian was equal to every other in the quantity of food consumed. This method of estimation was the most suitable for comparison in a study of changes in a national food supply. In order that the possibility of misconception may be avoided, however, certain supplementary data are presented in this section to show that many among the Japanese civilians were not as adequately provided for as the average figures indicate for a variety of reasons.

Estimates from the Household Statistics Bureau on food consumption in 1926 were made by the Ministry of Agriculture and Forestry. The results indicate that long before the war food consumption varied widely with occupation as shown in Table 36. In general, farmers fared much better than workers in any other occupation and salaried workers much worse.

A food consumption survey of 500 families with incomes of about 100 yen per month was conducted by the Osaka Prefectural Health Department in 1942 after rationing had gone into effect. The results of this survey bore out the prewar, prerationing findings shown in Table 36. The same study also determined the average actual daily food intake in that prefecture as given in Table 30. Comparison of the figures in that table with those for the 1942 national average given in Table 28 indicates considerable lack of agreement between the two, and in most cases, to the disadvantage of this group in the population. According to this survey residents of Osaka prefecture of moderate incomes in 1942 exceeded the national average in food intake for the vegetable group only. The consumption by the group, of grains other than rice, of beans and of meat and fish was far below the national supply level.

TABLE 30.—*Daily average food intake among Japanese, Osaka prefecture, 1942*

[grams per person per day]

Rice	400
Grains, other	14
Beans	4.5
Potatoes	37.5
Vegetables	345
Meat and fish	63.8
Seaweeds	6.4
Fats and oils	3
Miscellaneous	13.9
Total	888.1

Source: Survey of 500 families by Osaka Prefectural Health Department, 1942.

The observation of the Ministry of Agriculture in 1926 and in Osaka in 1942 that food intake by farmers was higher than the average was borne out by another type of analysis. From figures furnished the Survey by the Ministry of Agriculture it was possible to calculate the fraction of the total domestic production of staple foods which was consumed by farmers in 1940 and 1944. The results which are given in Table 31 indicate that the weighted average of farm consumption was 50 and 44 percent of total domestic production in 1940 and 1944, respectively. The fact that farmers at the same time made up only about one-fifth of the Home Island total population makes it evident that they were consuming much more of the staple foods than the average.

From figures furnished the Medical Division by the Hyogo Prefecture Food Control Office the daily per capita consumption of marine prod-

TABLE 31.—*Farm consumption of staple foods 1940 and 1944*

Food	1,000's metric tons		Percent of domestic production	
	1940	1944	1940	1944
Rice	4,388	3,404	38.2	32.5
Wheat and barley	1,782	1,685	51.0	55.0
Sweet potatoes	2,234	2,462	77.0	57.0
White potatoes	1,150	1,241	71.0	63.0
Total staple	9,554	8,792		
Weighted average			50.0	44.3

ucts was calculated and set down in Table 32. These figures compared to those in Table 28 year by year, show that urban dwellers in that prefecture consumed a much larger proportion of fish than the national average from 1941 through 1943. From that point to the end of the war they consumed less than the average because local catches fell off rapidly. The national average tended to be supported at the same time by catches from northern waters where war risks to the fishing vessels were smaller. Table 32 also shows the difference in consumption of these products by urban and rural populations in favor of the city dweller. Further, it presents evidence that consumption of processed marine products did not decline as rapidly as that of fresh and frozen fish.

TABLE 32.—*Consumption of marine products, Hyogo prefecture, Japan, 1941–45*

[Grams per person per day]

	1941	1942	1943	1944	1945
Urban areas:					
Processed	124	68	34	33	15
Fresh and frozen	259	113	101	41	30
Total	383	181	135	74	45
Rural areas:					
Processed	113	45	34	18	15
Fresh and frozen	169	45	34	26	23
Total	282	90	68	44	38

Source: Hyogo Prefecture Food Control Office.

The prewar 5-year average (1937–41) in Osaka prefecture for miso consumption was 24 grams per capita per day. With the advent of rationing this value dropped approximately one-half to 12.5 grams per day on the official ration. Although the published ration allowance was not altered officially, figures on distribution indicate the actual ration diminished to 9.5 grams per day in 1944. Under these circumstances the question may well be raised as to whether the official increase in the ration to 15 grams per day in June 1945 resulted in a comparable increase in actual consumer intake.

A similar situation existed in respect to Shoyu consumption. The prewar average was 38 millileters per capita per day. Rationing reduced this to 28 millileters per day officially while actual distribution fell to 24 millileters per day. The official decrease of June 1945 to 15.5 millileters per day, coupled with the dilution simultaneously authorized, brought intake to such a low level as to have seriously undermined food acceptability to the Japanese civilians. In Osaka prefecture average consumption in 1945 fell to 8.5 grams per day.

While the figures available relate only to Osaka prefecture, there is no reason to believe this region was especially favored in the matter of food distribution nor that consumers in other parts of the Home Islands fared any better. All evidence would seem to indicate therefore, that the official ration allowances of supplementary foods were maintained only fortuitously. Since the deviation in all cases could have taken the form of a reduction only, the consumers' average intake must have diminished more seriously than is indicated by the change in the official ration allowances.

Another substantial factor that caused the food consumption of the individual to vary from the national average was the degree of his ability to trade in the extensive black market. According to a summary prepared by the Japanese Institute of Public Health, investigations conducted by the Labor Investigation Society, the Wartime Living Consultation Society, the Central Price Cooperative Conference and the Toyama Steel Company indicate that about 50 percent of the food commodities consumed by the Japanese were purchased outside the government controlled distribution systems. Since food in the black market was characterized by prices ranging from three to five times the ceiling prices, it is immediately apparent that any individual with a low income, or with a moderate but fixed income, would suffer through his inability to make illegal purchases. After his savings had been consumed, even the possibility of exchanging his tangible property for food was soon restricted when the supply of expendable goods had been exhausted.

Deviations of individual levels of food con-

sumption from the national average, often of considerable magnitude, were shown in the foregoing section to have varied with geography, occupation and accessibility to supply and were due to failure of the official distribution system to deliver the allotted rations and the individual's inability to trade in the black market.

Levels of Nutrient Supplies

An understanding of the effects upon human health of changes in levels of food supplies in Japan can be reached only through nutritional analysis. The levels of nutrients supplied by those food commodities may be calculated from the quantity of nutrients per unit weight of the foodstuffs which occurred in the Japanese diet. Having estimated, in the previous section, the quantities of food available for consumption in terms of weight, the per capita levels of nutrient supplies contained in those quantities of foodstuffs have been calculated from the best information available on the nutrient composition of Japanese foods. As an indication of the vulnerability of the nutritional state of the nation to enemy attack against the food supply, the proportion of the total of each nutrient derived from different foods has been calculated from the per capita levels of nutrient supplies and is also discussed in this section. In addition, consideration has been given to the partition of calories between the carbohydrate, protein and fat fractions of the diet. Other nutritional aspects of the availability of nutrients have also been pointed out in the effects of substitution of other commodities for rice in the staple ration. As a means of showing the limitation of stating nutrient supplies as average some deviations are considered.

Supplies of principal nutrients.—The average prewar (1931–35) diet in Japan, while it was apparently fairly adequate as far as quantity was concerned, provided less than 2,150 calories per day. This quantity is hardly equal to the minimum requirement for the maintenance of health for even short periods of time. The average daily intake of carbohydrate was far too high in comparison to the intake of protein and fat at least as far back as 1925.[1]

The content of diet in respect to proteins containing adequate quantities of the essential amino acids and in respect to fats was also deficient. The questions of relative quantities and partition of nutrients are discussed in later sections. The supply of vitamins of the B complex, especially thiamine, was always marginal. In this scarcity of thiamine lies the basis for using the size of the rice crop as a very sensitive barometer of the rate of incidence of beriberi in Japan, as well as in other oriental countries.

The per capita quantities of nutrients contained in the quantities of foodstuffs shown in Table 28 and Figure 8 are presented in Table 33. This table was derived from the more detailed figures, which show the contributions of each type of food, given in Appendices B–1 to B–5. Calculations of the values given were based on tables of composition of Japanese foods developed by the Medical Division of the Survey from the best sources available in Japan, the United States and Great Britain. These data are not as refined as would be ultimately desirable or as may be developed as a result of more precise laboratory assays in the future. It is considered, however, that they are substantially accurate and indicate the broad trends with sufficient precision for the purposes of this study.

In comparing the values in Table 33 for calories and carbohydrate for the five years it will be noted that after an initial slight increase in 1942 and 1943 there was a consistent and sharp decline. During the entire 5 years there was a continuous decrease in the supplies of protein, fats, riboflavin and niacin. The rate of decline in total protein was accompanied by a faster decline in animal protein. This proportion indicates a decline in quality as well as quantity; a retrogression from a position which has always been precarious for Japan in this regard. The supply of thiamine was maintained at a practically constant but low level until the last year. Then it shared the fate of all other nutrients but one, and decreased rapidly. The fact that the level of thiamine did not diminish as quickly as that of the other B-complex vitamins may in part be attributed to the attempts of the government to retain the native thiamine content of rice through reduced polishing of the brown rice. The strong aversion of the Japanese toward eating rice only partially polished, however, seriously reduced the effectiveness of this well-advised step. The single exception to

[1] E. C. Grey, *The Food of Japan*, Health Organization of the League of Nations Publication III. 2, Geneva (1928).

ESTIMATED SUPPLIES OF NUTRIENTS AVAILABLE FOR CIVILIAN CONSUMPTION

JAPAN, 1941-1945

(PER CAPITA PER DAY)

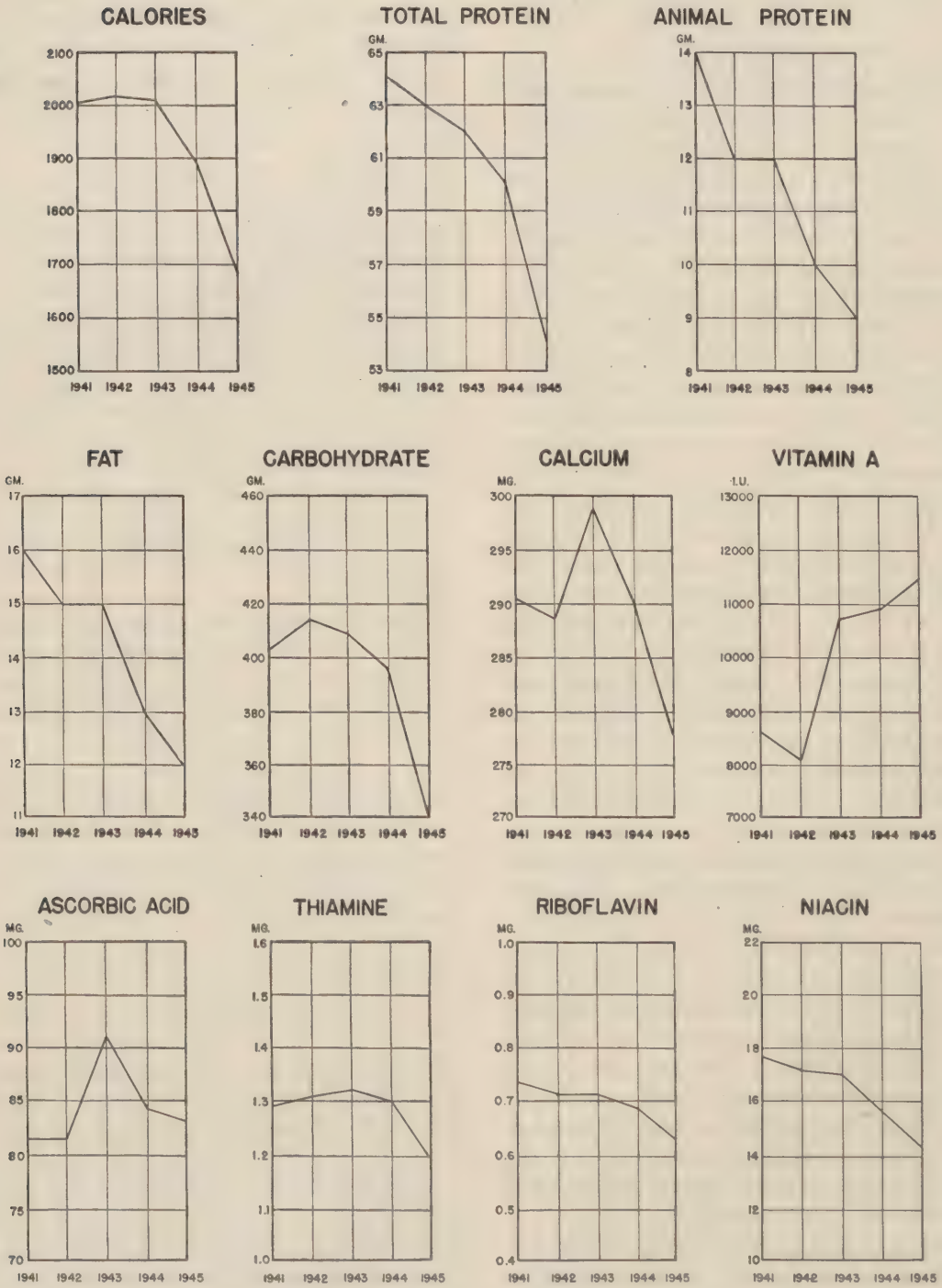


FIGURE 9

the general downward trend in nutrient supplies was vitamin A, which enjoyed a continuous increase to the end of the war, after an initial slump in 1942. These facts are illustrated in Figure 9.

TABLE 33.—*Estimated supplies of nutrients available for civilian consumption Japan, 1941–45*

[per capita per day]

Nutrient	1941	1942	1943	1944	1945
Fuel value (calories)	2,007	2,041	2,013	1,895	1,680
Protein, animal (grams)	14	12	12	10	9
Protein, vegetable (grams)	50	51	50	50	45
Total (grams)	64	63	62	60	54
Fat (grams)	16	15	15	13	12
Carbohydrate (grams)	404	415	410	388	341
Calcium (milligrams)	291	288	298	290	273
Vitamin A (International units)	8,534	8,019	10,749	10,986	11,302
Thiamine (milligrams)	1.29	1.31	1.32	1.30	1.19
Riboflavin (milligrams)	.73	.71	.71	.68	.63
Niacin (milligrams)	17.5	17.1	17.0	15.8	14.2
Ascorbic acid (milligrams)	82	82	91	84	83

Proportions of nutrients from different foods —Comparison of food supplies year by year on the basis of levels of nutrient supplies alone is incomplete. The vulnerability of the nutritional state of a nation at war is measured by the degree of its dependence on external sources of nutrients, especially those in critical supply. Figures for the percentage contribution of various foods to the total supply of each nutrient, in conjunction with data on the sources of the foods, indicate the specific effects on the health of the consumers which may be expected as a result of changes in the levels of commodity supplies. The same percentage figures reflect changes in acceptability to the consumer, including palatability.

The per capita food supplies shown in Table 28 and the levels of nutrient supplies given in Table 33 and Appendices B–1 to B–5 were analyzed for the proportions of each nutrient contributed by each food category. The results of these calculations are given as grams per capita per day and as percentages of the total quantity of each nutrient in Table 34. For ease in following trends and making comparisons the weight figures are plotted in Figures 10 and 11 as graphic reflections of the percentage contributions.

Calories—The contribution of rice to the total calorie intake, as might have been predicted, was the largest of any single food by far. The share of calories supplied by rice remained at a relatively constant level, on a percentage basis, during the entire war period despite the significant decline in the supply of rice shown in Table 28 and Figure 8. The calorie contributions of soybeans and grains other than rice likewise remained essentially unchanged at about 5 and 14 percent of the total intake, respectively. The only other observations of note are that sugar decreased from 6 percent to less than 1 percent and potatoes increased from 5.5 to almost 10 percent. It will be noted that the items the proportions of which remained unchanged depended in material measure on imports.

Protein—In the case of protein, contrary to expectations on the basis of experience with Western diets, the largest single contributor was again rice, varying between 42 and 45 percent. Fish, as second in importance, fell steadily from 20 to 14 percent during the five war years. This decline is of especial importance because fish was practically the only source of animal protein, and this decrease indicates a disproportionate drop in protein quality from a biological point of view. The soybean proportion increased slightly from 13 to 15 percent, while the portion contributed by grains other than rice fell off an equivalent amount to 10 percent. Here again, as in the case of calories, food commodities which were imported in large quantities maintained or advanced their proportionate standing among the contributors.

Carbohydrate — The seemingly ubiquitous rice again is the largest single contributor at approximately 65 percent of the total. This calls attention to the fact that the carbohydrates were the overwhelmingly large source of calories in the Japanese diet. This aspect will be discussed in greater detail in a later section. Thus, with the exception of soybeans, the discussion given for calories applies equally to the partition of carbohydrate, including the relation of imports.

Fat—"Visible" oils and fats shared almost equally with rice, fish and soybeans in the partition of the total fat intake and all declined continuously at comparable rates. Further discussion on this element is far outweighed in importance by the fact that the Japanese diet has always been remarkably poor in fats as will be shown later.

Vitamin A—The most important feature of

TABLE 34.—*Partition of nutrients in the Japanese diet, 1941–45*

[by weight and percent of total supply]

CALORIES

Food category	1941		1942		1943		1944		1945	
	Calories	Percent of total	Calories	Percent of total	Calories	Percent of total	Calories	Percent of total	Calories	Percent of total
Rice	1,146	57.1	1,204	59.0	1,224	60.8	1,122	59.2	1,047	62.3
Grains, other [1]	294	14.6	294	14.4	241	12.0	301	15.9	205	12.2
Sugar	124	6.2	124	6.1	96	4.8	56	3.0	8	.5
Potatoes [2]	111	5.5	106	5.2	152	7.6	144	7.6	163	9.7
Beans and soybeans	104	5.2	97	4.8	99	4.9	101	5.3	102	6.1
All others	228	11.4	216	10.6	201	10.0	171	9.0	155	9.2
Total	2,007	100.0	2,041	100.1	2,013	100.0	1,895	100.0	1,680	100.0

PROTEIN

Food category	1941		1942		1943		1944		1945	
	Grams	Percent of total	Grams	Percent of total	Grams	Percent of total	Grams	Percent of total	Grams	Percent of total
Rice	27.0	42.5	28.3	44.9	28.8	46.5	26.4	44.4	24.6	45.5
Fish	12.5	19.7	11.0	17.5	10.6	17.1	8.9	15.0	7.4	13.7
Soybeans [3]	8.0	12.6	7.7	12.2	7.7	12.4	8.0	13.5	8.1	15.0
Grains, other [1]	7.9	12.4	7.9	12.5	6.6	10.7	8.1	13.6	5.7	10.5
Vegetables	2.4	3.8	2.4	3.8	2.5	4.0	2.3	3.9	2.1	3.9
All others	5.7	9.0	5.7	9.0	5.7	9.2	5.7	9.6	6.2	11.5
Total	63.5	100.0	63.0	100.0	61.9	100.0	59.4	100.0	54.1	100.0

CARBOHYDRATE

Food category	1941		1942		1943		1944		1945	
	Grams	Percent of total	Grams	Percent of total	Grams	Percent of total	Grams	Percent of total	Grams	Percent of total
Rice	256.1	63.5	269.0	64.9	273.6	66.8	250.8	64.7	234.1	68.6
Grains, other [1]	61.0	15.1	61.1	14.7	50.0	12.2	62.6	16.2	42.7	12.5
Sugar	31.0	7.7	31.0	7.5	24.0	5.9	14.0	3.6	2.0	.6
Potatoes [2]	24.7	6.1	23.7	5.7	31.6	7.7	32.1	8.3	36.2	10.6
Vegetables	13.1	3.2	12.9	3.1	13.7	3.3	12.7	3.3	11.6	3.4
All others	17.6	4.4	17.1	4.1	16.9	4.1	15.3	3.9	14.7	4.3
Total	403.5	100.0	414.8	100.0	409.8	100.0	387.5	100.0	341.3	100.0

FAT

Food category	1941		1942		1943		1944		1945	
	Grams	Percent of total	Grams	Percent of total	Grams	Percent of total	Grams	Percent of total	Grams	Percent of total
Oils and fats [4]	4.1	25.3	3.1	20.4	3.1	20.5	1.1	8.5	1.1	9.0
Rice	3.4	21.0	3.5	23.0	3.6	23.8	3.3	25.6	3.1	25.4
Fish	2.6	16.0	2.3	15.1	2.2	14.6	1.9	14.7	1.5	12.3
Soybeans [3]	2.3	14.2	2.6	17.1	2.6	17.2	2.9	22.5	3.1	25.4
All others	3.8	23.5	3.7	24.3	3.6	23.8	3.7	28.7	3.4	27.9
Total	16.2	100.0	15.2	100.0	15.1	100.0	12.9	100.0	12.2	100.0

VITAMIN A

Food category	1941		1942		1943		1944		1945	
	Inter. units	Percent of total	Inter. units	Percent of total	Inter. units	Percent of total	Inter. units	Percent of total	Inter. units	Percent of total
Potatoes, sweet	5,621	65.9	5,159	64.3	7,777	72.4	8,316	75.7	8,855	78.3
Vegetables	2,315	27.1	2,273	28.3	2,410	22.4	2,241	20.4	2,051	18.1
Fruits	289	3.4	308	3.8	301	2.8	203	1.8	185	1.6
Fish	238	2.8	210	2.6	202	1.9	170	1.5	140	1.2
All others	71	.8	70	.9	59	.5	56	.5	73	.6
Total	8,534	100.0	8,020	99.9	10,749	100.0	10,986	99.9	11,304	99.8

ASCORBIC ACID

Food category	1941		1942		1943		1944		1945	
	Milligrams	Percent of total	Milligrams	Percent of total	Milligrams	Percent of total	Milligrams	Percent of total	Milligrams	Percent of total
Vegetables	50	61.7	50	61.0	52	57.1	49	57.6	45	53.6
Potatoes, sweet	12	14.8	11	13.4	17	18.7	18	21.2	20	23.8
Potatoes, white	8	9.9	8	9.8	9	9.9	8	9.4	10	11.9
Fruit	9	11.1	10	12.2	10	11.0	7	8.2	6	7.1
Seaweed	2	2.5	3	3.7	3	3.3	3	3.5	3	3.6
Total	81	100.0	82	100.0	91	100.0	85	100.0	84	100.0

THIAMINE

Food category	1941		1942		1943		1944		1945	
	Milligrams	Percent of total	Milligrams	Percent of total	Milligrams	Percent of total	Milligrams	Percent of total	Milligrams	Percent of total
Rice	0.58	45.3	0.61	45.9	0.62	47.0	0.57	43.2	0.53	43.4
Grains, other [1]	.23	18.0	.24	18.0	.19	14.4	.24	18.2	.16	13.1
Vegetables	.18	14.1	.17	12.8	.18	13.6	.17	12.9	.16	13.1
Potatoes [2]	.12	9.4	.12	9.0	.15	11.4	.16	12.1	.18	14.8
Beans and soybeans	.05	3.9	.06	4.5	.06	4.5	.07	5.3	.08	6.6
All others	.12	9.4	.13	9.8	.12	9.1	.11	8.3	.11	9.0
Total	1.28	100.1	1.33	100.0	1.32	100.0	1.32	100.0	1.22	100.0

RIBOFLAVIN

Food category	1941		1942		1943		1944		1945	
	Milligrams	Percent of total	Milligrams	Percent of total	Milligrams	Percent of total	Milligrams	Percent of total	Milligrams	Percent of total
Fish	0.24	32.9	0.21	29.2	0.20	27.8	0.17	23.9	0.14	21.9
Vegetables	.15	20.5	.15	20.8	.16	22.2	.15	21.1	.14	21.9
Rice	.12	16.4	.12	16.7	.13	18.1	.12	16.9	.11	17.2
Potatoes [2]	.06	8.2	.06	8.3	.08	11.1	.09	12.7	.10	15.6
Grains, other [1]	.06	8.2	.06	8.3	.05	6.9	.07	9.9	.04	6.3
All others	.10	13.7	.12	16.7	.10	13.9	.11	15.5	.11	17.2
Total	.73	99.9	.72	100.0	.72	100.0	.71	100.0	.64	100.1

NIACIN

Food category	1941		1942		1943		1944		1945	
	Milligrams	Percent of total	Milligrams	Percent of total	Milligrams	Percent of total	Milligrams	Percent of total	Milligrams	Percent of total
Rice	6.7	37.9	7.1	41.3	7.2	42.6	6.6	41.8	6.2	43.4
Fish	6.0	33.9	5.3	30.8	5.1	30.2	4.3	27.2	3.5	24.5
Grains, other [1]	1.6	9.0	1.6	9.3	1.2	7.1	1.7	10.8	1.2	8.4
Potatoes [2]	1.2	6.8	1.2	7.0	1.4	8.3	1.4	8.9	1.6	11.2
Vegetables	.7	3.9	.7	4.1	.7	4.1	.6	3.8	.6	4.2
All others	1.5	8.5	1.3	7.6	1.3	7.7	1.2	7.6	1.2	8.4
Total	17.7	100.0	17.2	100.1	16.9	100.0	15.8	100.1	14.3	100.0

[1] Wheat, barley, naked barley, maize, millet, kaoliang, buckwheat and oats.
[2] White and sweet.
[3] Including Miso and Shoyu.
[4] Including butter.

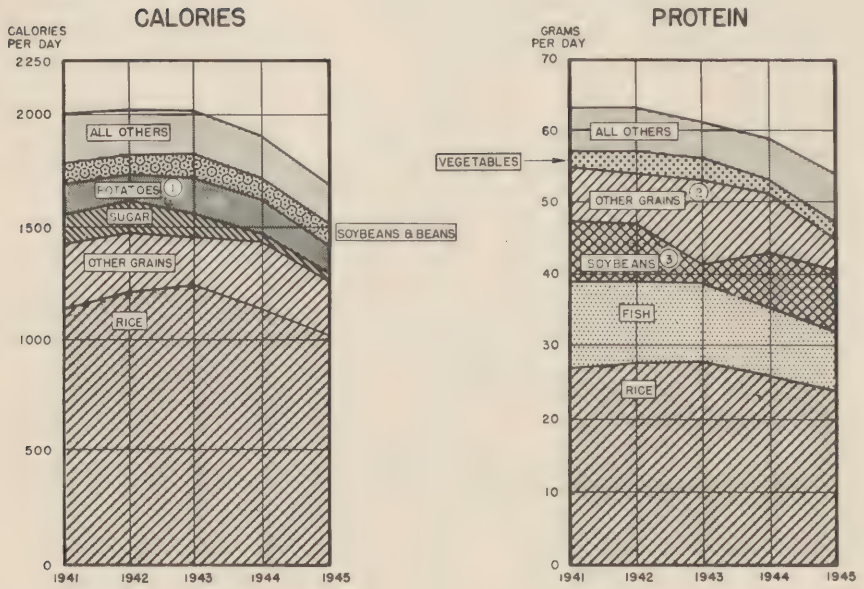
analyzing the vitamin A content of the Japanese diet for partition in terms of commodities is the explanation it gives of its unique climb when all other nutrients were declining. It may readily be noted that the increase in consumption of sweet potatoes as a substitute for rice caused the vitamin A intake to increase despite the declines suffered by all other contributors of this nutrient.

Ascorbic acid—In the case of ascorbic acid again the increase in consumption of potatoes, both white and sweet, accounted for the maintenance of the supply level although the largest contributor of this nutrient was the vegetable group at 50 percent. The supply of ascorbic acid was free of any influence of change in imports.

Thiamin and niacin—These were supplied in large measure by rice. The profile of total thiamine was largely determined by the quantity of rice available, with some support from other

PARTITION OF NUTRIENTS BY FOOD GROUPS(I)

JAPAN AVERAGE, 1941–1945



(1) WHITE AND SWEET
(2) WHEAT, BARLEY, MAIZE, MILLET, KAOLIANG, BUCKWHEAT, AND OATS.
(3) INCLUDING *MISO* AND *SHOYU*
(4) INCLUDING BUTTER

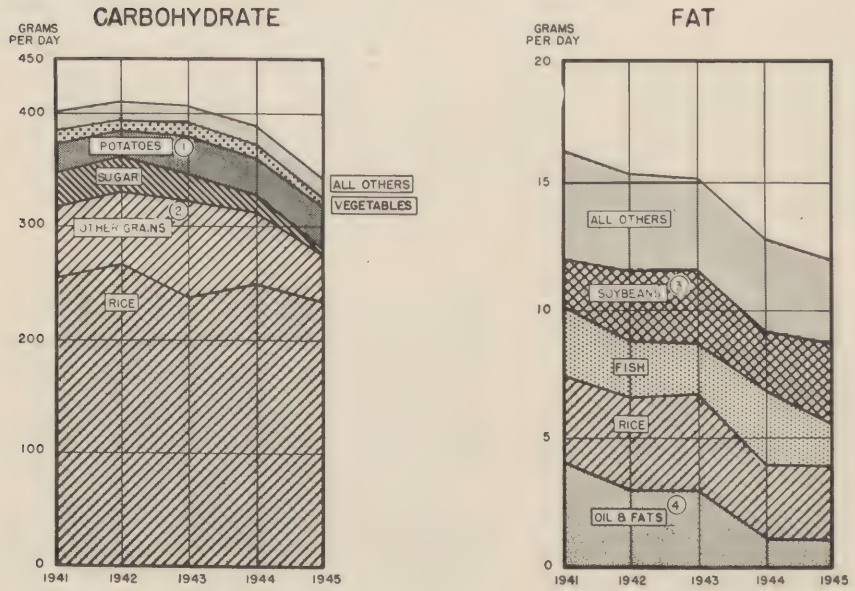
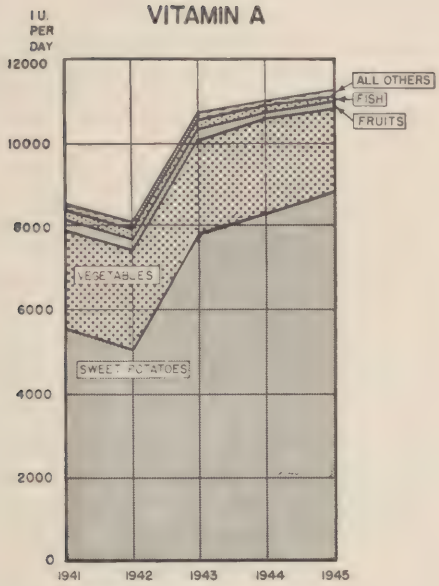
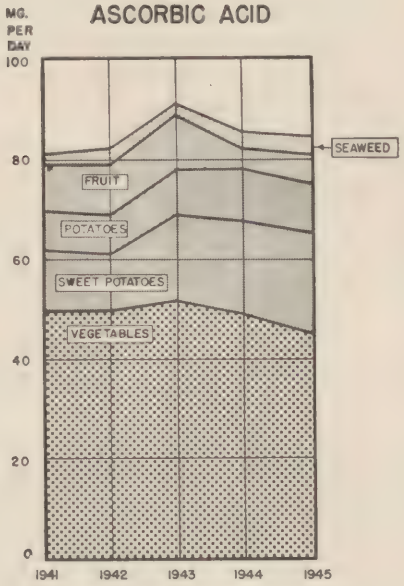


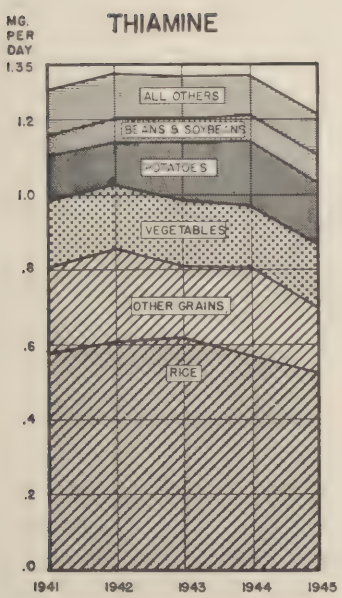
FIGURE 10

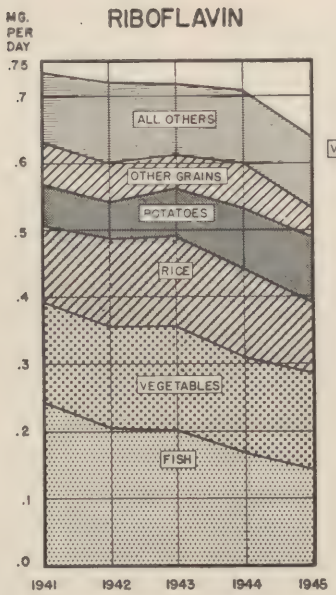
PARTITION OF NUTRIENTS BY FOOD GROUPS (II)

JAPAN AVERAGE, 1941-1945









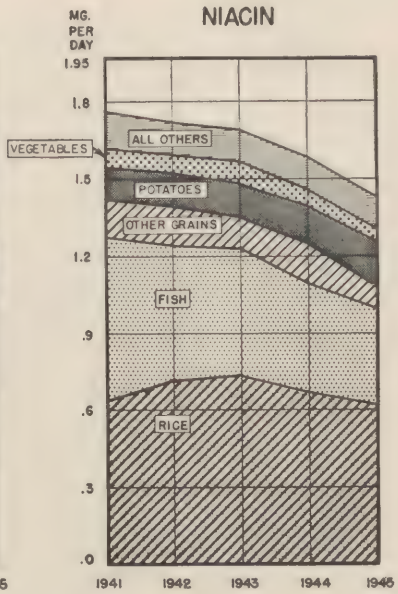


FIGURE 11

grains. The increase in consumption of potatoes helped offset the general decline in thiamine level. In the case of niacin it was the fish contribution which decided the decrease in supply. For both thiamine and niacin imported foodstuffs were an important factor in maintaining supply levels.

Riboflavin—The rate of decline in the quantity of riboflavin available was due almost altogether to the failing supply of fish. Increased potato consumption caused the only consistent increase in riboflavin intake.

To recapitulate the discussion on the partition of each nutrient among the various food commodities a short summary is presented with a view toward estimating the potential effects of enemy attack on the health of the civilian population. Of primary importance it has been noted that the supply level of rice, a vital fraction of which is imported, is the determining contributor of many nutrients. The connection between sizeable imports and significant contribution to the levels of nutrient supplies may be extended to all the commodities listed in Table 21. It is apparent from the data presented that the Japanese nutritional economy was extremely vulnerable to any serious cutback in imports of a few basic food commodities. It may also be noted that an informed evaluation of Japan's supply of nutrients would have indicated these facts to have been true at the onset of the war, as evaluation of the supply of food commodities did not.

Note. The usual practice in measuring national food supplies as they affect war potential has been to measure the levels of food commodities required to satisfy dietary customs rather than the levels of nutrient supplies which would be required to fulfill nutritional requirements. This has been attested by the failure, previously reported by the Survey, of the German war planners to be guided by the nutrient requirements of the civilian population in the defense of their country against Allied attack. In contradistinction, the British overcame much greater problems in their food economy by basing their planning in large measure upon nutritional requirements as shown by the report of the Combined Food Board (Food Consumption Levels in the United States, Canada and the United Kingdom, Washington, 1944).

On this basis it would appear that in combatting a nation dependent upon imports for supplies of basic food commodities to satisfy not only the dietary customs of its people, but also to supply the minimum level of essential nutrients necessary to the health of those people, judicious and early action to deny those imports would contribute greatly to an early and decisive victory. Japan could be considered such a nation.

Another conclusion which may be drawn from the data presented is that early action which would have interfered with the domestic production of rice and fish would have effectively lowered the supply of essential nutrients to the wretched state which was prevalent in Japan only at the end of the war. Attack against the rice crop itself at any critical point in its growth would have upset the nutritional state of the civilian population beyond hope of decisive recovery.

Carbohydrate-protein-fat-calorie ratio—From the figures on supplies of carbohydrate, protein and fat given in Table 33 and the well-established conversion factors, the partition of the total calories between these nutritive elements has been calculated and presented in Table 35. Nutrition experts have set no specific requirement for the quantity of carbohydrate in the diet comparable to the recommended allowances for other nutrients. However, when it is considered that carbohydrates furnished only 50 to 52 percent of the total calories in the United States, the 80 percent contribution in Japan would appear to have called for the adoption of vigorous measures toward improvement. Such measures, however, were never attempted by the Japanese. Even in the United Kingdom in 1943, pressed as it was by the war, carbohydrates contributed only 52 percent of the total calories. Since the only contribution which carbohydrates make to the diet is in the form of calories, it may be assumed that any diet containing an excessive fraction of carbohydrate is, due to the limitation of total bulk, proportionately lacking in the essential nutrients other than calories. It will be noted that the fat component of the diet never contributed more than 7.2 percent of the total calories. The values given in Table 35 in this respect may be compared to the United States and United Kingdom levels for 1943 of 38 and 36 percent, respectively.

Inequities in distribution of nutrients—The figures given in the foregoing section on per capita nutrient supplies and the observations derived from them have been concerned only with the average national experience. As such, and for reasons similar to those given in the section on commodity levels, they are limited in

TABLE 35.—*Carbohydrate-protein-fat partition of the Japanese diet*

WEIGHT BASIS

Year	Carbohydrate		Protein		Fat		Total	
	(Grams)	(Percent)	(Grams)	(Percent)	(Grams)	(Percent)	(Grams)	(Percent)
1925 [1]	537.6	83.6	88.5	13.8	17.5	2.7	643.6	100.0
1931–35 [2] (average)	446.2	86.3	57.7	11.2	13.2	2.6	517.1	100.1
1941	403.5	83.5	63.5	13.1	16.2	3.4	483.2	100.0
1942	414.8	84.1	63.0	12.8	15.2	3.1	493.0	100.0
1943	409.8	84.2	61.9	12.7	15.1	3.1	486.8	100.0
1944	387.5	84.3	59.4	12.9	12.9	2.8	459.8	100.0
1945 (average)	341.3	83.7	54.1	13.3	12.2	3.0	407.6	100.0
June 1–30, 1945	240.3	73.5	65.7	20.7	20.9	6.4	326.9	100.0

FUEL VALUE BASIS

Year	Carbohydrate		Protein		Fat		Total	
	(Calories)	(Percent)	(Calories)	(Percent)	(Calories)	(Percent)	(Calories)	(Percent)
1925 [1]	2,150	80.8	354	13.3	158	5.9	2,662	100.0
1932–35 [2] (average)	1,785	83.6	231	10.8	119	5.6	2,135	100.0
1941	1,614	80.1	254	12.6	146	7.2	2,014	99.9
1942	1,659	81.0	252	12.3	137	6.7	2,048	100.0
1943	1,639	81.0	248	12.3	136	6.7	2,023	100.0
1944	1,550	81.4	238	12.5	116	6.1	1,904	100.0
1945 (average)	1,365	80.7	216	12.8	110	6.5	1,691	100.0
June 1–30, 1945	961	68.1	263	18.6	188	13.3	1,412	100.0

[1] Grey, E. C.—*The Food of Japan*, League of Nations Health Organization Publication III.2, Geneva (1928).
[2] Figures from the Imperial Government Institute for Nutrition Research, Tokyo, Japan.

their indications of the quantity actually available to any given individual or group. It is possible for individuals or segments of the population to be undernourished, even to the point of starvation, at the same time that the average per capita intake of their country exceeds the quantities required for the maintenance of health. A more comprehensive understanding of the degree to which all segments of the population have been provided for and the extent to which individual adverse effects might be anticipated may be derived from supplementary information.

Deviations from national averages on intake of nutrients are most markedly shown among occupational categories of the population. The Ministry of Agriculture and Forestry estimated from Household Statistics Bureau food consumption figures for 1926 that wide variations occurred in distribution of nutrients to different workers. As may be noted from Table 36, it was found that salaried men consumed fewer calories and less protein per day than others. While calorie consumption was in some measure proportional to the degree of activity normally associated with the occupation, as is desirable, it is evident that farmers consumed a disproportionate share on this basis. The tendency indicated in the table for protein intake to parallel that of calories will be discussed in a later section.

TABLE 36.—*Distribution of nutrients among occupational categories* [1] *Japan, 1926*

Occupation category	Fuel value (calories/day)	Protein (grams/day)
Salaried men	2,506	68
Laborers	2,549	68
Miners	2,992	97
Farmers	3,265	98
Average	2,518	70

[1] Estimated from Household Statistics Bureau figures on consumption 1926, by Ministry of Agriculture and Forestry.

In February 1942, after the rationing of staple foods had gone into effect, a nutritional survey of Osaka prefecture was made by the prefectural health department. In six cities (not including Osaka) and one town, 500 families with an average income of about 100 yen per month (comprising 2,371 persons) were studied by trained personnel who visited the individual homes to obtain the information required. The results of the survey are given in part in Table 37. Their principal burden in this discussion is that wide variations are shown to exist among individuals of different occupations in respect to daily calorie and protein intake. From the figures presented it is evident that farmers consumed not only a disproportionate share of calories from all sources (except restaurant meals), but also of vegetable and total protein. Only in animal protein alone was their intake less than that for other groups. The fact that laborers consumed fewer calories than the other groups is presumptive evidence of maldistribution, since the requirements of this group must have been as high as or higher than those of the salaried or merchant groups. The simultaneous fact that laborers, whose income was notoriously low, derived few calories from nonrationed foods, indicated that the reason for the maldistribution was economic in this case and due to a comparative inability to afford black market prices.

TABLE 37.—*Intake of nutrients by occupation Osaka prefecture, 1942*

[per capita per day]

Occupation	Calories				
	Rice	Staple substitutes	Non-rationed foods	Restaurant meals	Total
Salaried	1,256	74	315	102	1,747
Merchant	1,350	64	250	88	1,752
Laborer	1,287	74	7	74	1,442
Farmer	1,632	77	335	----	2,044
Average	1,381	72	227	66	1,746

Occupation	Protein (grams)							Total
	Rice	Staple substitutes	Non-rationed foods		Home total		Restaurant meals	
			Animal	Vegetable	Animal	Vegetable		
Salaried	25.2	2.6	18.9	9.4	18.9	37.2	3.4	59.5
Merchant	27.7	2.2	18.3	9.8	18.3	39.7	3.4	61.4
Laborer	26.3	3.1	13.5	10.4	13.5	39.8	7.6	60.9
Farmer	34.3	3.5	3.2	10.3	3.2	48.1	----	51.3
Average	28.4	2.9	13.5	10.0	13.5	41.2	3.6	58.3

Source: Osaka Prefectural Health Department Survey, February 1942.

Studies in Osaka in 1942, 1943 and 1945 and in Tokyo in June 1945 indicate that food obtained on the so-called "ration" (more precisely through the official distribution channels) provided only approximately 80 percent of the total calorie intake and 70 percent of the total protein intake of the average consumer as shown in Table 38.

TABLE 38.—*Contribution of "rationed" foods to nutrient supplies Osaka, 1942–43*

Year	Calories			Protein		
	Total intake (number)	From "ration" (number)	Contribution of "ration" to total (percent)	Total intake (grams)	From "ration" (grams)	Contribution of "ration" to total (percent)
1942	1,929	1,471	76.3	66.0	44.0	66.7
1943	2,054	1,693	82.4	72.5	54.2	74.8

Source: Study by Osaka Municipal Physiology Research Laboratory.

These figures are supported by an investigation conducted by the Toyama Steel Co., on the sources of nutrients in its employees' diets. In this case 75 percent of the calories and 66 percent of the protein were derived from foods distributed through official channels. The remainder of nutrients was provided by foods from black market or "free purchase" sources. Since purchasing power, to a large degree, determines the extent of participation in the black market, it is evident that the shares of nutrients available to low- and fixed-income groups were reduced below the level indicated by the national average figures.

It has been shown in this section that even long before the war considerable variations occurred among the Japanese in level of nutrient intake in respect to occupation. According to these figures farmers were in a relatively advantageous nutritional position at the expense of individuals in other occupations. That these variations continued after the government assumed control of food distribution has also been supported. In addition, evidence has been presented from which it may be concluded that the existence of a large black market in food supported inequities in distribution that denied low- and fixed-income groups their proper share of the supply of nutrients.

Effect of substitution on the nutrient value of the staple ration—As noted in the foregoing section a large fraction of the total supply of calories was derived from "rationed" food commodities. In Table 34 and Figures 10 and 11 it was also shown that a considerable contribution was made by rice to the per capita supply of several important nutrients. The substitution of potatoes and other grains in lieu of rice in the staple ration was reported in the section on rationing. Since the nutrient value of one food is, in general, different from another, the question may reasonably be raised as to the nutritional effect of the rise in adulteration of the staple ration. In order to determine whether the consumers suffered any loss in availability of nutrients, a nutritional analysis of the substitution is presented in this section.

When other grains were used in the staple ration in place of rice, the rate of substitution was on an equal weight for weight basis according to the Ministry of Agriculture's Food Control Bureau. When white potatoes and sweet potatoes were used, the ratio was 180 kan and 140 kan, respectively, for each koku of rice. The rate of substitution of each commodity is reduced to a uniform basis with rice equal to 1.0000 in the first column of Table 39. For comparison with rice the nutrient value of each substitute was calculated on the basis of the ratio thus established. The nutrient values thus derived are presented in Table 39 in two sections. In the first section they appear as the

TABLE 39.—*Effect of substitution on nutrient value of staple ration*

Food	Substitution factor [1]	Calories	Protein (gm.)	Fat (gm.)	Calcium (gm.)	Carbohydrate (gm.)	Vitamin A (I.U.)	Thiamine (mg.)	Riboflavin (mg.)	Niacin (mg.)	Ascorbic acid (mg.)
	Per 100 grams rice equivalent										
Rice	1.0000	340	8.0	1.0	20	76	0	0.172	0.035	2.0	0
Wheat	1.0000	355	9.0	.9	5	76	0	.275	.050	.8	0
Barley	1.0000	352	9.0	1.7	50	73	0	.267	.080	3.1	0
White potato	6.9592	424	10.3	.6	60	97	121	.545	.242	7.3	91
Sweet potato	4.7127	471	7.1	2.8	118	104	36,000	.471	.282	3.3	80
	Index with base rice equals 100										
Rice		100	100	100	100	100	100	100	100	100	100
Wheat		104	113	90	25	100	100	160	143	40	100
Barley		104	113	170	250	96	100	155	229	155	100
White potato		125	129	60	300	128	[2]	317	691	365	[2]
Sweet potato		139	89	280	590	137	[2]	274	806	165	[2]

[1] 140 kan (or kwan) sweet potato or 180 kan white potato equals one koku rice (Food Control Bureau, Ministry of Agriculture and Forestry).
[2] Indicates this value, on purely mathematical grounds, would be infinitely greater than the value for rice.

amount of nutrient supplied in each case by the quantity of substitute food equivalent to 100 grams of rice. In the second, for ease of comparison, these values were all reduced to an index in which the nutrient value of rice was taken to be the base value and equal to 100. The index values will be found in the lower section of Table 39.

On the basis of the figures given it may be noted that, when wheat was the substitute used, the consumer received less calcium and niacin, but more protein, thiamine and riboflavin. When barley was the adulterant the ration improved in all respects, especially in the levels of thiamine, riboflavin and niacin. White potatoes, at the ratio stated, provided more calories, protein, calcium and all vitamins; the only loss was in the fat value. Sweet potatoes exceeded the white potato contribution of vitamin A, but were a somewhat inferior source of protein.

The adulteration of wheat flour with potato starch which was officially sanctioned in Japan during the war, as it had been in Germany, raised a question similar to that discussed above. In this case, however, the answer is more readily apparent. Since starch contains none of the nutrients of wheat other than calories and carbohydrate, it is apparent that its use as an adulterant of flour could only have caused a general decrease in the nutritive value of flour.

It may be concluded from these findings that substitution of other commodities for rice in the ration, at the ratios stated, was advantageous to the consumer on the basis of nutrient intake. Psychologically, however, the replacement of rice by any other food could only have produced an adverse effect among the Japanese.

Nutrient Requirements

The calculation of levels of nutrient supplies for any country implies an ultimate comparison of these levels with the nutritive requirements. While reasonably accurate estimates of this type have been in use in the United States and other Western countries, an equivalent degree of development has not been obtained in Japan. Variations in average height and weight, in sex and age distribution and possibly other factors make it impossible, by any simple means, to adapt requirements which are applicable to one country to any other. Consequently, it is necessary to estimate the requirements of the Japanese population on the best information available. This section discusses the estimation of the more important nutritive requirements of Japan.

Individual allowances—In an attempt to express the calorie and protein requirements of the Japanese the Imperial Government Institute for Nutritional Research in Tokyo developed, during the war, a table of estimated allowances. This table was expressed in terms of average individual intake requirements (i.e. actually ingested) and was broken down by age, sex and degree of activity. It is reproduced in slightly modified form in this report as Appendix B–6. The values contained in Appendix B–6 were intended to parallel the "Recommended Dietary Allowances" published by the Food and Nutrition Board of the National Research Council of the United States (National Research Council Reprint and Circular Series No. 122, August 1945 pp. 10, 11). On this basis they are equivalent at least to the average physiological

requirements of each consumer category rather than the minimum in each case. Other more restricted standards which attempted to approach more nearly the minimum intake levels for use during wartime were estimated by the Committee on Efficiency of Nutrition of the Institute of Hygiene at the Kyoto Imperial University. They are reproduced in Appendix B–7 for comparison. The special requirements of pregnant and nursing women estimated by the Institute for Nutrition Research are shown in Appendix B–8.

The National Research Council standards for individuals in the United States were used by L. A. Maynard as a basis for calculating similar allowances for individuals in China. The computation took account of the body weights of individuals and the effect of the high carbohydrate content on the digestibility of the diet that might reasonably be expected in that country. Since the average body weights among Japanese are practically identical with those used by Maynard and the carbohydrate content of the Japanese diet is also high, Maynard's values are reproduced here as Table 40.

TABLE 40.—*Suggested nutrient allowances* [1], *National Research Council (U.S.A.)*

Subject	Calories	Protein [2] (grams)	Calcium (grams)	Iron (miligrams)
Man (55 kilograms):				
Sedentary	2,000			
Moderately active	2,400	65	0.6	9
Very active	3,500			
Woman (48 kilograms):				
Sedentary	1,800			
Moderately active	2,200	60	.7	10
Very active	2,600			
Pregnancy	2,200	85	1.3	13
Lactation	2,600	100	1.7	13
Children:				
Under 1 year	[3] 100	[3] 3.5	1.0	6
1–3 years	1,100	40	.9	6
4–6 years	1,500	50	.9	7
7–9 years	1,700	60	.9	9
10–12 years	2,100	70	1.0	10
13–15 years:				
Girls	2,200	80	1.1	13
Boys	2,700	85	1.2	13
16–20 years:				
Girls	2,100	75	.9	13
Boys	3,200	100	1.2	13

[1] From *Suggested Nutrient Allowances for China for Use by U. S. Agencies* by L. A. Maynard approved by the Committee on International Food Value Problems. These allowances "are meant to apply to nutrients as eaten and are described as sufficiently high to include normal persons who are less efficient in utilization. They are thus considered to include a factor of safety of approximately 30 percent for the person of average nutritional needs."

[2] These values assume a digestibility of protein of 80 percent because of the high proportion of carbohydrate in the diets of the Far East.

[3] Kilograms.

In order to provide a ready means of comparison between the various standards for calories, Table 41 has been compiled from various sources of intake requirements for individuals of moderate activity. It will be noted that, in calculating allowances for Japanese, use was made of basal metabolic requirements estimated by the Imperial Government Institute for Nutrition Research in 1944. These figures are given in Appendix B–9.

TABLE 41.—*Comparison of daily calorie requirements for persons of moderate activity*

Population	Source	Calories	
		Male	Female
United States	National Research Council (U.S.A.) [1]	[2] 3,000	[3] 2,500
Chinese	National Research Council (U.S.A.) [4]	[5] 2,400	[6] 2,200
Japanese	National Institute for Nutrition Research (Japan) [7]	[8] 2,400	[9] 2,000
Japanese	National Institute for Nutrition Research (Japan) [10]	[11] 2,500	[12] 2,200
Japanese	F.A.O. "emergency subsistence" [13]	[14] 1,900	
European [15]	F.A.O. "emergency subsistence"	[16] 2,200	
Japanese	F.A.O. "temporary maintenance" [17]	2,200	
European [15]	F.A.O. "temporary maintenance"	[16] 2,500	

[1] *Recommended Dietary Allowances (Revised 1945)* of the Food and Nutrition Board, National Research Council, Reprint and Circular Series No. 122, Washington, D. C. (August 1945). Includes a safety factor of approximately 30 percent for the person of average nutritional need.

[2] 70 kilograms (154 pounds).

[3] 56 kilograms (123 pounds).

[4] *Suggested Nutrient Allowances for China for Use by U. S. Agencies* of the of the Committee on International Food Value Problems of the National Research Council by L. A. Maynard (June 21, 1945).

[5] 55 kilograms (120 pounds).

[6] 48 kilograms (106 pounds).

[7] Calculated from Japanese Institute for Nutrition Research formula (16/9 times basal metabolism) using basal metabolism from table of the same institute.

[8] 31–50 years; 1.56 square meters of body surface.

[9] 31–50 years; 1.40 square meters of body surface.

[10] Same as [7], except basal metabolism from prediction tables of Harris and Benedict, *A Biometric Study of Basal Metabolism in Man*. Carnegie Institution of Washington, Publication No. 279, Washington, D. C. (1919).

[11] 55 kilograms (120 pounds); 159 centimeters body height; 32 years.

[12] 47 kilograms (103 pounds); 147 centimeters body height; 32 years.

[13] Food and Agriculture Organization of the United Nations. "An emergency subsistence food consumption level needed to prevent the most serious under-nutrition leading to disease and the danger of civil unrest."

[14] Calculated from [4] according to method of Food and Agriculture Organization of the United Nations as given in *Technical Supplement No. 1, Nutrition*, Meeting on Urgent Food Problems, Washington, D. C. (May 20, 1946). Assumptions: 1:1, male:female proportion; distribution of age groups as shown in table 45.

[15] Food and Agriculture Organization "A population which as regards age, sex, and activities is approximately the same as that of the United States."

[16] From Food and Agriculture Organization technical supplement No. 1.

[17] Food and Agriculture Organization "A temporary maintenance level sufficiently high to maintain populations in fairly good health, but not for rapid and complete rehabilitation."

For nutritive requirements other than calories and protein, standards applicable to the Japanese are almost nonexistent. A committee of the Institute for Nutrition Research in Japan compared the estimates of several Western and Japanese experts for the vitamins and in 1943 accepted as standards the values given in Table 42. These are the only estimates that have been made of Japanese vitamin requirements, to the knowledge of the Medical Division of the Survey.

Of allowances for other nutrients only one additional estimate is available: that of the National Research Council for fat. Quoted below is the pertinent extract from "Recommended Dietary Allowances:"

In spite of the paucity of information on the subject (of fat requirements) there are several factors which make it desirable that fat be included in the diet to the extent of at least 20 to 25 percent of the total calories and that the fat intake include "essential" unsaturated fatty acids . . .

TABLE 42.—*Daily vitamin requirements* [1]

Age or category	Vitamin A (International units)	Vitamin B (milligrams)	Vitamin C (milligrams)
0–6	2,000	0.5	40
7–12	4,000	1.0	40
13–20	6,000	1.5	50
Above 21	5,000	1.0	40
Laborers	6,000	1.5	60
Pregnant women	6,000	1.5	50
Nursing mothers	7,000	2.0	60

[1] Accepted 22 Aug. 1943, by the Imperial Government Institute for Nutrition Research, Tokyo, Japan.

Average intake requirements—The standards given in the foregoing section are for individuals. In order that they may be used to compare on a statistical basis the levels of nutrient supplies of a country with the average per capita requirements of that country it is necessary to adjust these individual allowances for pertinent characteristics of its population. In addition, in order to make the allowances useful in a comparison of "minimum" supplies, they must be adjusted for "minimum" requirements.

The Food and Agriculture Organization of the United Nations convened a committee of nutrition experts to estimate the average restricted requirements of populations in urgent need of food to prevent actual starvation as a result of post-war disruptions of supply. The committee defined a "TEMPORARY MAINTENANCE" level of calories as one which was "sufficiently high to maintain populations in fairly good health, but not for rapid and complete rehabilitation" and calculated its magnitudes for European populations (*Technical Supplement No. 1, Nutrition,* Meeting on Urgent Food Problems, Washington, 20 May 1946). On the basis of the F.A.O. definition and data presented elsewhere in this report, the Medical Division calculated the comparable standard for Japan under wartime conditions of restricted food supply to be 2,200 calories per day at the level of food distribution used throughout this report. The detail values from which this figure was derived is shown in Table 43. The F.A.O. definition of an "EMERGENCY SUBSISTENCE" level "needed to prevent the most serious under-nutrition leading to disease and civil unrest" was similarly adopted as a basis for calculation and yielded a value of 1,900 calories per day for Japan. Details of this are given in Table 44. The approximate distribution of the population in Japan in respect to pertinent consumer categories used in calculating restricted requirements is given in Table 45.

TABLE 43.—*Temporary maintenance per capita calorie and protein intake for Japan*

Category	Calories (per day)	Protein (milligrams per day)
0–2 years	825	30
3–5 years	1,300	45
6–9 years	1,500	55
10–17 years	2,000	60
Pregnant and nursing women	2,000	85
Normal (sedentary) consumers:		
Male	1,750	60
Female	1,600	60
Moderate workers	2,000	60
Heavy workers	2,400	60
Very heavy workers	2,900	60
Average for Japan: [1]		
Intake	1,900	59
Retail level	2,200	

[1] Calculated using values in the table above with population distribution of Japan during the war years and assuming all adults to be moderate workers in accordance with method used by F.A.O. Preparatory Nutrition Committee.

The 300-calorie differential is based upon the fact that self-suppliers represent 34 percent of the total population and accounts for 44.3 percent of total consumption of staple foods, as was the case in 1944.

F.A.O. average intake reduced by 15–20 percent; as suggested in *Report on World Food Situation, Technical Supplement No. 1, Nutrition;* is 1,760–1,870 calories per day.

TABLE 44.—*Emergency subsistence per capita calorie intake for Japan*

Category	Calories (per day)
0–2 years	825
3–5 years	1,100
6–9 years	1,250
10–17 years	1,650
Pregnant and nursing women	1,700
Normal (sedentary) consumers:	
Male	1,500
Female	1,350
Moderate workers	1,700
Heavy workers	2,000
Very heavy workers	2,500
Average for Japan: [1]	
Intake	1,600
Retail level	1,900

[1] Calculated using values in the table above with distribution of population of Japan during the war years and assuming all adults to be moderate workers according to method used by F.A.O. Preparatory Nutrition Committee.

The 300-calorie differential is based upon the fact that self-suppliers represent 34 percent of the total population and accounts for 44.3 percent of total consumption of staple foods, as was the case in 1944.

F.A.O. average intake value reduced by 15–20 percent; as suggested in *Report on World Food Situation, Technical Supplement No. 1, Nutrition;* is 1,520–1,615 calories per day.

Relation of Nutrient Supplies to Requirements

This section discusses per capita levels of nutrients contained in the food supplies available for civilian consumption in Japan during the war in relation to estimated Japanese requirements. Sufficient data on which to make

TABLE 45.—*Distribution of population in Japan (approximate, 1944)*

Category	Number
0–2 years	1,733,000
3–5 years	3,723,000
6–9 years	4,959,000
10–17 years	5,257,000
Pregnant and nursing women	3,626,000
Adults (not including women above)	54,000,000
Total	73,298,000
Total	[1] 73,000,000
Rationed	[1] 48,000,000
Self-suppliers [2]	[1] 25,000,000

[1] Figures indicated are approximations.
[2] 25,000,000 self-suppliers constitute approximately 34 percent of the total population.

comparisons to a degree as refined as would be desirable have not been available. However, the features most significant to this study may be adequately outlined. The values of the estimates to be discussed have been derived in previous sections. The supplies of food commodities were presented in Section 3; the levels of nutrients contained in those food commodities in Section 4; and the estimated requirements in Section 6. Per capita levels of nutrients available are shown in Table 33 and Appendices B–1 to B–5.

Calorie—The supply levels indicate only the amount of energy which may be derived from the quantities of foods available for consumption. The difficulties encountered in estimating average calorie requirements are suggested by the complexity of and differences within the tables of requirements presented. Since all work is done at the expense of calories ingested, it is evident that when the intake of calories is insufficient to provide the energy expended, body fat and protein must be expended to make up the deficit with attendant loss in body weight. Otherwise, the degree of activity must be reduced until it is commensurate with the calories contained in the food which is available.

Since no accurate data on the average intake requirement of Japan for calories have been developed, an approximation must be arrived at by consideration of the estimates available. From Table 41 it is evident that estimates of requirements of Japanese individuals of "moderate activity" on a "good" diet vary from 2,000 calories actual intake per day for women and 2,400 for men to 2,200 and 2,500, respectively. The latter values are in practical agreement with those published by the National Research Council and are considered to be applicable to Japan. The Japanese Imperial Government Institute for Nutrition Research estimated the average requirement to be 2,160 calories per day for a standard approaching the optimum. The Committee on Efficiency of Nutrition at Kyoto Imperial University set up 1,950 calories as the standard of average restricted wartime requirements. The "TEMPORARY MAINTENANCE" and "EMERGENCY SUBSISTENCE" calorie levels defined by the Food and Agriculture Organization of the United Nations in estimating the requirements of populations in urgent need of food were calculated to be 2,200 and 1,900 calories per day, respectively, for Japan as shown in Tables 43 and 44.

Comparison of the estimates given above with the supplies of nutrients available (Table 33) indicates that the Japanese level of supply was at no time during the war up to the standard of a "good" diet for individuals of "moderate activity" in respect to calories, according to the United States National Research Council definition. Nor did calorie intake ever attain the average "good" diet level of the Japanese Institute for Nutrition Research standards. After 1943, neither of the two restricted average standards of the F.A.O. nor the average standard of the Japanese Committee on Efficiency of Nutrition were met.

On the basis of this comparison it must be concluded that the energy content of the wartime Japanese diet at no time attained the level necessary for the active work required of civilians in modern war. There is serious doubt that body weights could have been maintained after 1943, even at reduced levels of activity. Despite supplementary allowances authorized for children and pregnant and nursing women, it would be not unreasonable to conclude that a significant and increasing margin existed between the food supply and the special nutrient requirements of these important consumer groups during the war. It is difficult to imagine that serious under-nutrition leading to the danger of disease and civil unrest could long have been averted had the supply of calories continued to have been restricted to the late 1944 and 1945 estimated levels.

Protein—During the entire war the per capita supplies of total protein did not meet the requirements as estimated by any of the expert sources previously mentioned for a "good" diet.

It is possible that the levels may have exceeded slightly the F.A.O. "TEMPORARY MAINTENANCE" standard until 1945; during 1945 it is doubtful that even that restricted standard was attained. The higher requirements of pregnant and nursing women for protein could not have been attained at the average level at any time. On considering the special nutritional value of animal protein, the situation appears to have been even worse. The requirements for biologically superior protein are not established to date, but the value of a variety of protein sources has been clearly recognized. It is doubtful that the average Japanese wartime diet contained sufficient quantities of all the "essential" amino acids to have prevented the appearance of deficiency symptoms.

Fat—The intake of fat in Japan during the war declined at a slower rate than that of the other nutrients, but it was at no time adequate. The best estimates of fat requirements indicate that it should be contained in the diet to a minimum of 20 to 25 percent of the total calories. The maximum contribution of calories ever made by fat in the wartime Japanese diet was only approximately 7 percent of the total. No data are available as to whether the requirements for specific "essential" unsaturated fatty acids, such as arachidonic, were fulfilled at any time.

Carbohydrates—No specific allowance for carbohydrate intake is laid down as standard by nutrition experts. The analysis presented in the section of this report on the carbohydrate-protein-fat-calorie ratio, however, indicates that the proportionate carbohydrate content of the Japanese diet was at all times far too high despite a declining absolute value for the level of that nutrient.

Calcium—A comparison of the calcium content of the average diet, presented in Table 33, with the requirements shown in Table 40 indicates that the calcium intake was at all times far below the average level estimated to have been necessary.

Vitamin A and ascorbic acid (vitamin C)—The intake levels appear to have exceeded both the National Research Council estimate of requirements and those of the Japanese given in Table 42. Adverse effects indicative of shortages of these vitamins are probably not to be expected to have occurred, except for individuals whose intake deviated markedly from the average level.

Thiamine, riboflavin and niacin—These supplies appear to have been hardly adequate to maintain even individual actual intake at the "average (restricted) intake requirement" defined by the National Research Council as the minimum for emergency use over limited periods of time only (Bulletin, vol. III, pp. 24–30). If the standards for individual actual intake were adjusted to the appropriate average value at the retail level of distribution, it is evident that a significant margin must have existed between the supplies and the requirements of these important vitamins to the detriment of the consumers.

Summary

This section of the report of the Medical Division presents a study of the effects of the strategic bombing of Japan on the supplies of food commodities and nutrients available to its civilian population during the war with the United States. The trends in the levels of food supplies have been analyzed in terms of the amounts of food commodities and esential nutrients available on a daily per capita basis.

Within the limits of the statistical data and scientific knowledge at hand, interpretation of the analytical results has allowed the general outline of the facts to be drawn.

Domestic agricultural production, the fish catch in Home Island waters and imports from the mainland of Asia and the Pacific islands were the sources of the food supply available for domestic consumption; all were severely curtailed during the war. The loss of vital imports of basic foods was a large factor in causing an over-all reduction in available supplies. Fertilizer production and consumption declined principally as a result of seriously diminished imports of finished fertilizers and of the raw materials from which they were manufactured. Bombing destroyed many fertilizer factories in the Home Islands, but this had little or no effect on crops produced before the termination of hostilities. The direct effects of factory destruction were to be borne by crops harvested only after the war and that in full and continuing measure.

Bombs also caused the destruction of food stocks to the extent of approximately 220,000 metric tons but only in the last 6 months of

the war. These losses, while small in comparison to total annual consumption, were approximately equivalent to the savings accumulated in 5 months (in 1945) from the 10 percent reduction which was ordered in the rice ration.

Food processing industries suffered extensive bomb damage, but the dispersal of the industry and its comparative lack of importance in Japan's food economy made this direct effect of bombing practically negligible in the overall situation.

The distribution of food over long distances was impeded when inter-island and coastwise shipping was curtailed by blockade and truck transportation was restricted to conserve gasoline. The collection and distribution of foods at rail terminals suffered badly when the fire bombing of urban areas destroyed freight handling facilities or impeded their operation. The loss of containers and vehicles used in local food transportation in the incendiary raids was also a factor in increasing the inadequacy of food distribution.

Rice was rationed immediately after the initiation of the war and soon all other foods were incorporated into the system of government control. Despite control and the restricted initial rations, the government was able to maintain the size of the rice ration until July 1945 only by adulteration. Allowances of other foods fluctuated at random, always declining in reflection of the failing total supply of food.

Analysis of the per capita supply of foods on an average daily basis indicates an almost continuous deterioration in the supply of all foods available for civilian consumption, except potatoes and soybeans.

Individual levels of food consumption deviated markedly from the national average and varied according to the occupation and accessibility of supply to the individual. Especially notable in this respect was the tendency for farmers to consume a disproportionate share of agricultural products at the expense of other consumer categories. The variations came about when the official distribution system failed to deliver the authorized ration allowances and when the ability of the individual to purchase food outside the ration was restricted for economic reasons. The existence of an extensive black market in food was a primary contribution to the inequities noted.

Japan's prewar supply of nutrients was inadequate and was further diminished in almost all respects beginning with the onset of the war. In this connection Germany had been more fortunate in having had a more adequate level of nutrients initially, of having exploited her conquests more successfully for her home population and in not having suffered a significant reduction of nutrient levels until the last 6 months of hostilities. The levels of available protein (especially from animal sources), fat, riboflavin, niacin and thiamine declined continuously in Japan during the five war years. The calorie and carbohydrate content of the diet increased slightly in the first year of the war, but joined the other nutrients in their precipitous and continuous decline thereafter. The only advantageous changes which occurred in nutrient levels during the 1941 to 1945 period were the maintenance of ascorbic acid intake and the increase in vitamin A intake.

The contribution of rice to the levels of all the principal nutrients, except vitamin A and ascorbic acid, was of primary importance. Additional large shares were added to the total supply of nutrients by other grains and soybeans. Since Japan's economy of nutrients depended, in significant measure, on imports of these foods, the decline in imports was a substantial factor in diminishing the total supplies of nutrients available for consumption by the civilian population. It is suggested that early and judicious action to deny food imports to the Home Islands and to attack domestic crops (especially rice) and the fishing industry from the air would have contributed to an earlier reduction of nutrient supplies to the desperate level which became prevalent in Japan only as the end of hostilities approached. Such a reduction might well have resulted in an earlier termination of hostilities than was actually the case.

The ratio of calories contributed by the carbohydrate, protein and fat fractions of the diet, which had always been poor in Japan, was not improved during the war.

Wide variations which occurred in Japan in levels of nutrient intake between individuals before the war were not corrected when control of the national food supply was assumed by the government as a war measure. Farmers continued to maintain a relatively advantage-

ous nutritional status, in fact increased it, at the expense of other consumer groups, especially those in the low- and fixed-income brackets in urban areas.

The substitution of other grains and potatoes for rice in the staple ration was, in general, advantageous to the consumers from a nutritional point of view, but only by indirection. Psychologically, however, the replacement of rice by any other food created a deleterious effect on the morale of the Japanese people.

When a comparison is made between the supplies of nutrients available for civilian consumption in wartime Japan and the estimated average intake requirements, it appears that only in the case of vitamin A and ascorbic acid did the supplies exceed the requirements. The negative margin between supplies and requirements for the other nutrients was significant in 1941 and increased continuously in almost all instances until the cessation of hostilities. Especially for calories, animal protein, fat and thiamine, the occurrence of specific deficiency symptoms on a general scale is believed to have been a definite possibility.

The interrogation of Sakomizu (Chief Cabinet Secretary in the Suzuki government) by members of the Survey reveals that the food situation was one of the principal factors which made it apparent in May 1945 that Japan could not continue the war.

The analysis of the Japanese wartime food supply on the basis of daily per capita levels of the principal nutrients indicates Japan's vulnerability in respect to imports. Therefore, when access to vital imports of food was denied Japan by the blockade, the supply of necessary nutrients was curtailed below the minimum consistent with even a semblance of continued health. The strategic bombing program, the main weight of which was brought to bear between March and July 1945, accelerated the rate at which imports of food were declining; decisively concentrating on this target at an earlier date would have eliminated the mainspring of Japanese resistance. If transportation in the Home Islands and domestic crops had also been chosen as targets the effect would have been further accentuated.

While Japan was regimented, poor and technically backward, the lessons pointed out by the effects of strategic bombing on the supply of foods and nutrients are not without application to the defense of the United States.

EFFECTS OF WARTIME NUTRITION

During this survey a number of cities and prefectures were visited and many physicians and health authorities were interviewed to determine the effects of the war and strategic bombing upon the nutritional status. Because of destruction by bombing and the disorganization that came with the war, medical records were difficult to obtain and, because of the general inadequacy of clinical and laboratory facilities, very little recent or current work on the nature of nutritional diseases in Japan could be examined by the Medical Division.

Neither the time nor the clinical anl laboratory facilities were available to the Medical Division to adequately examine groups of Japanese or to evaluate their nutritional status. Necessarily then, the material presented in the following pages is based almost entirely on information obtained from Japanese physicians and health authorities. Much information, essential for an accurate, definitive report could not be obtained and much of the information obtained was of doubtful reliability. Nevertheless, the materials collected do lend themselves to some analyses which disclose certain important general trends in the nutritional status of the Japanese during the war and which permit a few general conclusions.

From the standpoint of the conduct of the war, the most important population groups seriously affected by the adverse wartime food situation in Japan were:

Industrial workers,
Salaried workers,
Pregnant women, nursing mothers, infants and children.

The effects of wartime diets upon these groups are discussed in the following three sections. A fourth section is devoted to an account of the nature and prevalence of specific manifestations of malnutrition in Japan during the war.

Industrial Workers

Physiological requirements—The calories required to maintain health and to do a given amount of work in any occupation depend upon an individual's basic requirements for mainte-

nance and growth; his efficiency at the job; the suitability of the tools and facilities provided; the degree of mechanization of processes involved in his work; the length of his working day; his extracurricular activities; the composition of his diet and the number and spacing of his meals; and a number of other factors, few of which are standard to all factories or to all individuals. The system of extra rations for industrial workers used in Japan was based on the Japanese Imperial Government Institute for Nutrition Research definition of calorie and protein requirements for various occupational groups.

Japanese Standards

The detailed recommendations of the Institute for Nutrition, as shown in Appendix B–6 imply a degree of accuracy and definitude that hardly seems possible. In attempting to apply these recommendations, one must remember that they can furnish only an approximation of the average requirements for an occupation; that there is considerable overlapping in the requirements of different age groups and of the two sexes; and that the energy expenditure by workers in an industry can be reduced by improved working conditions, increased mechanization and curtailment of the workers' extracurricular activities. Examples of the Institute's occupational classifications of light, medium and heavy work are set forth in the footnotes of Appendix B–6.

The principle apparently adopted by the Japanese, that the protein requirement of an adult increases as energy expenditure increases, has not been accepted by the Food and Nutrition Board of the National Research Council of the United States. On the contrary, the Board has recommended a constant allowance of protein for all adults of like weight and sex, regardless of energy expenditure. Incidentally, the United States Board's "recommended daily allowance" of 70 grams of protein for a 154-pound man is less than the 75 grams recommended by the Japanese Institute for Nutrition for 31- to 50-year-old men engaged in light industry (average weight about 114 pounds), and is considerably less than the 90 grams recommended for men in the same age group employed in heavy industry (average weight about 116 pounds). It is, as a matter of fact, below any level recommended by the Institute for Nutrition for Japanese adult males under the age of 51 years.

The recommendations of the Institute for Nutrition, as given in Appendix B–6, probably represent an attempt on the part of the Institute to arrive at the optimum calorie and protein needs of Japanese industrial workers, and do not indicate the minimum amounts required by the workers to produce satisfactorily for a protracted period of time.

These calorie recommendations ranged from about 8 to 21 percent higher than the physiological requirements "under wartime conditions" ascertained by the Japanese Public Health Committee on the Efficiency of Nutrition, which are set forth in Appendix B–7. Some examples of the Committee's occupation categories are given in the footnotes of that appendix.

The Institute for Nutrition's estimate of 2,160 calories for the average per capita requirements in Japan is 11 percent greater than the 1,950 calories arrived at by the Committee on the Efficiency of Nutrition for the average per capita need under wartime conditions.

Results of Osaka Studies

During 1944, the Osaka Municipal Physiology Research Laboratory published the results of a series of experiments designed to ascertain the minimum amounts of protein and calories necessary to maintain human life. In the first experiment, three men and four women engaged in light work about the laboratory were studied to determine the effects of, first, a 20 percent reduction in their calorie intake, and second, the effects of a 30 percent reduction.

The three men ranged in weight from about 45.5 to 52 kilograms (100 to 115 pounds), and the women from about 43 to 62.5 kilograms (95 to 138 pounds). During the initial "standard feeding period," without regard for the differences in weight and possible differences in requirements, all the men were given a diet containing 2,172 calories and 75.6 grams of protein and all the women received 1,888 calories and 69.6 grams of protein. This appears to have involved a reduction in their customary calorie intake, because during this period every subject except the smallest, Tomita, lost weight, three of them losing more than 1 kilogram. There followed a period of 28 days on a diet reduced 20 percent in calorie value (to 1,747 calories for the men and 1,537 calories for the women). Again weight loss occurred in every

subject except Tomita (Table 46), but the weight reached a fixed point about midway in this period. Further weight losses occurred when the calorie content was reduced 30 percent below that of the "standard feeding period" (to 1,560 calories for the men and 1,350 for the women). In three out of five subjects, recovery of lost weight was practically complete after 14 days on the standard diet.

TABLE 46.—*Loss in weight due to reduction in calorie intake (percent of standard weight)*

[percent of standard weight]

Period	Tamura (male)	Fukuhara (male)	Kubo (male)	Nakajima (female)	Komatsu (female)	Kawamura (female)	Tomita (female)
Standard feeding period (12 days)	100.0	100.0	100.0	100.0	100.0	100.0	100.0
20 percent calorie reduction period (28 days)	98.8	97.3	95.4	96.1	96.5	97.6	99.8
30 percent calorie reduction period (22 days)	----	96.1	95.4	94.5	93.8	----	98.4
Recovery period (14 days)	----	99.4	98.9	96.3	95.9	----	101.0

Study by the Osaka Municipal Physiology Research Laboratory.

That the reduction in weight was genuine and the calorie intake insufficient to maintain the body weight of most of the subjects was confirmed by the decreased respiratory quotients and increased urinary nitrogen excretions observed, indicating increased catabolism of fat and protein.

Other reactions included the reduction in the hemoglobin content of the blood during the 30 percent calorie reduction period, (Table 48) and the development of a negative nitrogen balance during the 20 percent reduction period in two of the three male subjects for which nitrogen balance studies were done (Table 49). No studies of nitrogen balance were made during the 30 percent reduction period. Although the protein intake of the males was reduced from 75.6 grams to 70.9 grams in the 20 percent calorie reduction period, the amount they received during this period should have been sufficient to maintain all of them in a state of positive nitrogen balance, provided that they had adequate calorie intakes. The females received 65.4 grams of protein during the 20 percent calorie reduction period as compared to 69.6 grams during the standard feeding period. During the 30 percent calorie reduction period, both the males and females obtained quantities of protein about equal to the amounts in the diets of the standard feeding period; 74.2 and 75.6 grams, respectively, for the males, and 69.7 and 69.6 grams, respectively, for the females.

In general, it was found that Japanese males on 1,750 calorie diets and adequate in all other respects and Japanese women on 1,550 calorie diets (representing a 20 percent reduction from the "normal") which were otherwise adequate, did not suffer any significant ill effects and could perform light work satisfactorily over short periods of time. Weight losses occurred at these calorie intakes but the weights of both men and women soon reached fixed points. The mental and physical reactions became somewhat sluggish and efficiency was slightly impaired. In this connection it must be emphasized that this was a short-term study; the subjects were on the 20 percent calorie reduced diets only 28 days, and it cannot be inferred from the results that the subjects could have maintained health and work output indefinitely on such diets. In fact, the experimental findings implied the contrary. However, this study did indicate that reductions of calorie intake of 10 percent or more below the levels recommended by the Japanese Institute for Nutrition (Appendix B–6) could be tolerated by Japanese industrial workers for a protracted period without impairment of their physical capacity to perform the work required.

The male subjects maintained on 1,560 calories (30 percent calorie reduction period) and the females on 1,350 calories showed diminished energy and endurance and there was decrease in both voluntary and involuntary body activity. Oxygen consumption and calorie production dropped (Table 47). The calorie intake during this period was definitely inadequate for all subjects.

Further experiments performed by the Osaka Municipal Physiology Research Laboratory on other subjects showed:

That diets in which all of the protein was of vegetable origin (largely from soybeans) and sufficient in quantity (about 75 gm), maintained subjects in positive nitrogen balance and were nutritionally adequate.

That total protein intakes of 1 gram per kilogram of body weight were insufficient to maintain male subjects kept on 1,750 calorie diets and female subjects on 1,550

TABLE 47.—*Changes in metabolism with reduction in calorie intake*

Period	Duration (days)	Respiratory Quotient: Male average	Respiratory Quotient: Female average
Standard feeding	6–7	0.94	0.96
Calorie reduction, 20 percent	10–11	.90	.95
	25–26	88	.93
Calorie reduction, 30 percent	5–6	.86	.95
	11–14	.82	.94
	20–22	.83	.86
Recovery	15–22	.91	.93

Period	Duration (days)	Oxygen consumption: Male average (milliliters/minute)	Oxygen consumption: Male average (percent)	Oxygen consumption: Female average (milliliters/minute)	Oxygen consumption: Female average (percent)
Standard feeding	6–7	158	100.0	161	100.0
Calroie reduction, 20 percent	10–11	153	96.8	155	96.3
	25–26	151	95.6	152	94.4
Calorie reduction, 30 percent	5–6	142	89.9	156	96.9
	11–14	140	88.6	150	93.2
	20–22	142	89.9	146	90.7
Recovery	15–22	157	99.4	165	102.5

Period	Duration (days)	Nitrogen content of urine: Male average (grams/1 hour)	Nitrogen content of urine: Female average (grams/1 hour)
Standard feeding	6–7	0.289	0.350
Calorie reduction, 20 percent	10–11	.401	.425
	25–26	.372	.422
Calorie reduction, 30 percent	5–6	.353	.384
	11–14	.383	.452
	20–22	.372	.344
Recovery	15–22	.705	.499

Period	Duration (days)	Energy production: Male average (calories)	Energy production: Male average (percent)	Energy production: Female average (calories)	Energy production: Female average (percent)
Standard feeding	6–7	1,121	100.0	1,130	100.0
Calorie reduction, 20 percent	10–11	1,068	95.3	1,116	98.8
	25–26	1,056	94.2	1,059	93.7
Calorie reduction, 30 percent	5–6	982	87.6	1,084	95.9
	10–14	954	85.1	1,056	93.5
	20–22	975	87.0	1,010	89.4
Recovery	15–22	1,155	103.0	1,213	107.3

Study by the Osaka Municipal Physiology Research Laboratory.

TABLE 48.—*Blood hemoglobin levels as affected by low calorie intake (percent of standard normal)*

[percent of standard normal]

Subject	Standard feeding period 8th day	20 percent Calorie reduction period: 10th day	20 percent Calorie reduction period: 22d day	30 percent Calorie reduction period: 7th day	30 percent Calorie reduction period: 12th day	30 percent Calorie reduction period: 22d day	Recovery period 16th to 28th day
Males:							
Tamura	80	86	92				75
Fukuhara	79	82	80	76		75	67
Kubo	79	83	88	75	77	68	62
Females:							
Nakajima	80	81	78	75	72	63	65
Komatsu	78	82	82	82	72		66
Kawamura	76	81	82				67
Tomita	78	81	81	65	64	75	75

Study by the Osaka Municipal Physiology Research Laboratory.

TABLE 49.—*Nitrogen balance studies during periods of low calorie intake*

Subject	Type of period	Day of period	Nitrogen (grams)				Nitrogen ratio Intake: excretion	Average difference
			Intake in 24 hr.	Excretion				
				Urine	Feces	Total		
Tamura (male)	Standard feeding period	5	12.096	9.006	2.224	11.230	+0.866	0.169
		6		10.290	2.224	12.514	−0.418	
		7		9.814	2.224	12.038	+0.058	
	Calorie reduction period, 20 percent	9	10.742	11.305	2.345	13.650	−2.908	−2.330
		10		9.436	2.345	11.781	−1.039	
		11		11.440	2.345	13.785	−3.043	
Fukuhara (male)	Standard feeding period	5	12.096	8.241	2.433	10.674	+1.422	+2.073
		6		7.481	2.433	9.914	+2.182	
		7		7.048	2.433	9.481	+2.615	
	Calorie reduction period, 20 percent	9	10.742	7.579	1.908	9.487	+1.255	+1.203
		10		8.540	1.908	10.448	+0.294	
		11		6.775	1.908	8.683	+2.059	
Kubo (male)	Standard feeding period	5	12.096	8.755	2.657	11.412	+0.684	+1.415
		6		7.588	2.657	10.245	+1.851	
		7		7.730	2.657	10.387	+1.709	
	Calorie reduction period, 20 percent	9	10.381	9.099	3.152	12.251	−1.870	−1.441
		10		8.462	3.152	11.614	−1.233	
		11		8.450	3.152	11.602	−1.221	

Study by the —Osaka Municipal Physiology Research Laboratory.

calorie diets.

The quantities of protein given the subjects in this experiment amounted to 50 gm for the males and 45 gm for the females and were not determined for each individual according to his actual weight. It is quite likely that one gram of protein per kilogram of body weight would have proven sufficient if the subjects of the experiment had received diets more adequate in calorie content. During the preliminary normal diet period the males had received 2,200 calories and 75 gm of protein and the females had received 1,900 calories and 70 gm of protein.

Supplementary ration allowances—As explained in the previous section on food supply, the Japanese rationing system provided for supplementary allowances of the staple ration for workers in a number of occupations. The total allowances, as set up by the national government, varied not only with the degree of activity but also with sex, age and urbanization. The ration in the six large cities was generally larger than that in other cities and towns, and rural people received the smallest rations. Furthermore, the composition of the ration varied with the prefecture, depending upon the size of local stocks of cereals, soybeans and potatoes. The prefecture usually made the final determination of both the groups of workers to receive extra rations and the size of those supplementary allowances. Thus, industrial workers in different occupations and different sections of the country did not fare alike.

Compared with other workers—The average nutrient values of the diets of farmers, salaried men and laborers in 1926, as determined by the Government Statistical Bureau, are shown in Table 50. The findings of a Ministry of Health and Social Affairs survey of industrial workers in 1943, along with the appropriate recommended allowances of the Institute for Nutrition, are given in Tables 51 and 52. Although the findings for 1942 and 1943 showed a substantial reduction in the average calorie values of the diets of industrial workers below the average diets of laborers in 1926, the average values found by the Ministry of Health and Social Affairs for workers' diets in all industries appear to have been reasonably adequate during 1942 and the first half of 1943, except perhaps for heavy workers in the metal industries. Even in the metal industries (foundries, rolling mills, etc.) the average calorie value of the diets may have been satisfactory as women, as well as men, were employed there. The proportion of women to total employees in the factories surveyed was not indicated in the Ministry's report.

Inequities in food distribution—Unfortunately, the findings of the Ministry of Health and Social Affairs were not based on individual food consumption studies, but were compiled from reports by the factories on foods distributed to them and to the workers. When food is distributed to large groups and organizations, inequities in redistribution to individuals can be expected, particularly in Japan.

TABLE 50.—*Nutrient values of the diets of farmers, salaried men and laborers in 1926*

Subject	Total grams	Protein (grams)			Fat (grams)	Carbohydrate (grams)	Total calories
		Animal	Vegetable	Total			
Farmers	811	13	85	98	18	658	3,265
Salaried men	612	21	47	68	22	498	2,506
Laborers	642	20	52	72	20	521	2,614

Study by the Japanese Government Statistical Bureau.

TABLE 51.—*Average daily calorie and protein intake per worker in various industries, 1943* [1]

Industry	102 factories [2]			14 factories [3]			Recommended allowances [4]		
	Calories	Protein (grams)		Calories	Protein (grams)		Calories	Protein (grams)	Percent of recommended calories received (males, 1943)
		Total	Animal—total ratio		Total	Animal—total ratio			
Metal	2,463	90.4	0.286	2,365	99.3	0.322	M–3,100 F–2,400	M–95 F–80	79.4
Chemical	2,414	92.8	.270	2,766	118.0	.377	M–2,800 F–2,200	M–90 F–75	86.2
Machine	2,364	83.7	.274	2,650	89.2	.317	M–2,800 F–2,200	M–90 F–75	84.4
Textile	2,175	85.2	.355				M–2,500 F–2,000	M–85 F–70	87.0
Average	2,375	85.4	.276	2,557	94.4	.323			
Average of 116 factories in 1943	2,400	89.7	.282				[5] M–2,100 [5] F–1,800	[5] M–77 [5] F–67	114.3
							[5] M–2,800 [5] F–2,200	[5] M–90 [5] F–75	85.7

[1] Survey by Ministry of Health and Social Affairs.
[2] In Tokai, Kinkai and Kanto districts.
[3] In Kyushu and Chugoku.
[4] Institute for Nutrition recommendations for 21–30-year-age group at comparatively heavy work. In 1942 about 79 percent of all factory workers were between 15 and 30 years of age.
[5] Average "wartime allowance" for all men and women between ages of 20 and 29 years recommended by the Public Health Committee on Efficiency of Nutrition; obtained from Institute of Hygiene, Kyoto Imperial University, Kyoto, Japan.

TABLE 52.—*Food situation in factories in 1942 and 1943*

Name of plant	Period of study	Total number of workers studied	Female personnel (percent of total)	Cost of food (Sen)	Protein		Calories	
					Total (grams)	Animal—Total ratio	Total	Basic food—Total ratio
Watanabe Co. Inc., Iron Works (Kyushu region).	*1942* 10/25–11/4	3,600	1.8	43.8	73.1	0.326	2548	0.781
	1943 5/10	26,005	9.7	46.0	93.4	.324	2353	.744
	Difference			+2.2	+20.3	—.002	—195	—.037
Sachibukuro Machine Co.	*1942* 10/27–11/3	236	5.4	57.0	103.7	.344	3050	.794
	1943 5/29	1,410	4.2	69.0	56.2	.534	2095	.695
	Difference			+12.0	—47.5	+.190	—955	—.099
Nippon Kasei Kogyo K.K. Kurosaki Works.	*1942* 10/28	1,224	51	73.8	84.0	.343	2307	.760
	1943 6/6	9,908	30	65.0	118.0	.377	2766	.776
	Difference			—8.8	+34.0	+.034	+459	+.016
National average	1942 (23 factories)			47.4	78.6	.299	2405	.822
	1943 (116 factories)			53.2	89.7	.282	8400	.788
	Average difference			+5.8	+11.1	+.017	—5	—.044

Survey by Ministry of Health and Social Affairs.

When the amounts of foods distributed are barely adequate in quantity, as was true in Japan in 1942 and 1943, slight inequities in redistribution can be of major importance and cases of malnutrition may be expected to develop among the ultimate recipients.

The proportions of factory workers consuming the various amounts of calories, are shown in Table 53. About 84 percent of the workers received less than 65 percent of their calories

from the staple foods—rice, beans and cereals—in 1943; whereas from 1931 to 1935, according to the Institute for Nutrition, these foods accounted for 79 percent of the calories in the average Japanese diet. The protein content of the workers' diet appears to have been ample in 1943, as indicated by Table 54.

TABLE 53.—*Calorie consumption by factory workers, 1943*

Calories	Percent of workers	Calorie (Staples—total ratio)	Percent of workers
2900–3000	2.0	1.05–1.15	1.0
2800–2900	2.9	.95–1.05	2.0
2700–2800	0.9	.85–0.95	0.0
2600–2700	12.7	.75–0.85	6.1
2500–2600	19.6	.65–0.75	7.1
2400–2500	10.9	.55–0.65	38.7
2300–2400	15.7	.45–0.55	36.7
2200–2300	9.8	.35–0.45	8.2
2100–2200	13.8		
2000–2100	6.9		
Less than 2000	4.9		
	100.1		99.8

TABLE 54.—*Protein consumption by factory workers, 1943*

Protein (grams)	Percent of workers	Protein Ratio Animal: total	Percent of workers
140–150	0.9	0.50–0.60	0.7
130–140	0.0	.40–.50	2.9
120–130	0.9	.30–.40	41.2
110–120	3.9	.20–.30	35.5
100–110	5.9	.10–.20	16.7
90–100	20.6	.0–.10	2.9
80–90	28.5		
70–80	26.5		
60–70	8.8		
50–60	0.9		
40–50	2.9		
	99.8		99.9

Survey of 102 factories by Ministry of Health and Social Affairs.

Weight loss studies—The average calorie value of the daily meals served in the dormitory of the Nakijima Aircraft Factory are shown in Table 55. The physician at this factory found

TABLE 55.—*Daily calorie value of meals of Nakajima Aircraft Factory*

Year	Calorie intake (daily average)
1939	2,800
1940	2,400–2,000
1941	
1942–1945	1,600–1,900

that in 1939 the 15-year-old boys gained an average of seven kilograms in 12 months on 2,800 calories daily. In 1940 and 1941 the 15-year-old boys on 2,000 to 2,400 calories daily gained only two to three kilograms a year. Because of this they tried to keep the average daily intake at 2,400 calories, but as Table 55 shows, they were unable to do so. From 1942 to 1945 the average annual gain in weight of 15-year-old boys was only about 1 kilogram and many lost weight. Boys who went home to the country on mid-winter vacations increased their consumption while there and usually brought supplies of food with them on returning to work. It was customary for such boys to gain two or three kilograms in weight during their vacations, even though they had not been gaining previously.

TABLE 56.—*Average daily calorie and protein intake of male workers in 44 factories in Tokyo area*

Year	Total calories	Protein (percent)	
		Total	Animal
1938	3,012	91.9	32.1
1939	2,821	92.6	29.7
1940	2,781	93.7	43.7
1941	2,626	85.5	33.7
1942	2,433	81.6	28.9
1943	2,301	77.4	23.5

Source: Ministry of Health and Social Affairs.

Studies conducted by the Ministry of Health and Social Affairs in 44 factories in the Tokyo area show that in 1943 the calorie value of the workers diet had reached a seriously low level, 18 percent below the value recommended by the Institute for Nutrition for men between the ages of 17 to 30 years engaged in comparatively heavy work (Table 56). Evidence of malnutrition is apparent in the decreased weights of 15,- 16- and 17-year-old boys in these factories in 1942 and 1943 (Table 57).

TABLE 57.—*Average weights of males in factories in Tokyo area* [1]

[Kilograms]

Year	Age in years						
	14	15	16	17	18	19	20
1938	37.8	42.6	44.5	48.0	51.5	51.7	53.0
1939	41.0	43.0	46.0	49.0	50.7	52.4	53.3
1940	40.7	42.5	45.2	48.5	50.3	51.1	51.3
1941	40.9	43.5	46.0	48.2	50.3	52.5	51.5
1942	39.1	41.9	44.9	48.0	51.1	52.6	52.0
1943	39.3	40.7	43.2	47.0	50.8	52.8	52.6

[1] Average of 50,000 individuals in 44 factories.
Source: Ministry of Health and Social Affairs.

Analysis of diets—The general food supply situation deteriorated rapidly in 1944 and 1945. The calorie value of the diets of certain urban workers in Osaka prefecture in 1945 are shown in Table 58. These values were computed by using a figure of 78 percent as the average pro-

TABLE 58.—*Calorie intake of urban male workers, Osaka prefecture, August 1945*

Occupation	Age	Cereal ration (grams)	Calorie from ration [1]	Intake total	Recommended allowance [2] (calories)	Intake—Requirement ratio
Wood cutters and miners.	11–15	549	1,922	2,464	[3] 2,900	85
	16–60	486	1,701	2,181	3,450	63
	over 60	459	1,607	2,060	[3] 2,350	88
Factory workers.	11–15	522	1,827	2,342	2,650	88
	16–60	459	1,607	2,060	2,800	74
	over 60	432	1,512	1,938	[3] 2,350	82
Harbor workers.	11–15	612	2,142	2,746	2,900	95
	16–60	549	1,922	2,464	3,450	71
	over 60	522	1,827	2,342	[3] 2,350	100

[1] The cereal ration contributed about 78 percent of the total calories.
[2] Japanese Imperial Government Institute for Nutrition values.
[3] The Institute for Nutrition makes no specific recommendations for calorie requirements of individuals under 16 or over 60 in the very-heavy-work category; figures used are those given for heavy work for ages below 16 and for comparatively heavy work for those over 60.

portion of the total calories supplied by the workers' combined basic and supplementary rations. The calorie value of the cereal ration was taken as 3.50 calories per gram. All rations were reduced by 10 percent in the six large cities of Japan in August 1945, and in the remainder of the country in July 1945.

From the data in Table 58 it appears that in 1945 workers in the 16–60-year age group, about 95 percent of all industrial workers in Japan were receiving insufficient calories to perform satisfactorily the work expected of them. The actual situation was worse than the averages would indicate, as some individuals obtained much less than their proportionate share of the available food supply. In 1944, according to studies compiled by the Japanese Institute of Public Health, about 50 percent of all food purchased was obtained by "free purchase," that is, through the black market.

The Medical Division has made no attempt to compute the vitamin and mineral contents of the workers' diets as the data furnished by the various governmental and professional agencies in Japan did not lend themselves to such analysis. However, the reduction in supplies and consumption of cereals, particularly unpolished rice, soybeans, fish and vegetables, undoubtedly resulted in a deterioration of the vitamin and mineral values of the diet.

Clinical and statistical evidence—Evidences of nutritive deterioration in the health of Japanese industrial workers actually appeared prior to the onset of the war. Pulmonary tuberculosis among both men and women was on the increase as early as 1940 and became much more prevalent in 1942. The average body weight of male industrial workers decreased in 1938 and again in 1941 and 1942 (Table 59). However, this weight decrease was largely due to non-nutritional factors, such as the induction of the most able-bodied men into the armed forces.

TABLE 59.—*Yearly variations in the body weight of factory workers*

[Kilograms]

Classification	1936	1937	1938	1939	1940	1941	1942
Male	52.96	52.68	51.55	51.54	51.89	51.33	50.75
Female	46.16	44.61	44.50	44.86	45.22	44.76	44.95
Over 30 years [1]			53.68	53.96	53.84	53.60	53.70
From 17–30 years of age [2]	49.86	52.24	53.00	53.14	52.72	52.81	52.87

Survey by Japanese Institute of Public Health.
[1] All observations on same 3,661 subjects.
[2] All observations on same 1,095 subjects.

According to Japanese government health insurance records, the incidence of beriberi among industrial workers decreased markedly after 1938, but increased in 1942, the last year for which reliable records are available. The highest monthly rate attained in more than 7 years was about 28 cases of beriberi per 1,000 male workers. Authorities of the Institute of Public Health stated that the incidence of beriberi among industrial workers did not increase from 1943 to 1945. In their opinion, the decrease after 1938 was due to the more extensive use of incompletely polished rice and to the distribution of thiamine and vitamin B complex tablets to industrial workers. According to them, there were sufficient quantities of these vitamins for distribution to the Army and Navy and to factory workers throughout the war. The Nakajima Aircraft Co., for example, gave each of its employees three tablets containing a total of 1 milligram of thiamine daily, and claimed to have had very little beriberi among them.

Absenteeism—According to the Institute of Public Health the incidence of gastro-intestinal disorders increased in 1943 "because of malnutrition." Absenteeism because of illness of three or more days duration increased among both men and women workers from 1938 to 1942. According to the Institute of Public Health, absenteeism from all causes rose sharply in 1943 (Table 60). The food shortage was among the most important causes of absentee-

ism from then until the end of the war. Although some of the lost time was due to actual malnutrition and illness, it also represented time taken by the workers to forage for food. In 1944 and 1945 it was customary for workers to go on periodic expeditions to purchase foods directly from the farmers. Factory attendance,

TABLE 60.—*Absenteeism among factory workers, all causes (working days lost as percent of total)*

Year	Male	Female
1937	2.5	2.8
1938	2.8	3.4
1939	2.9	4.0
1940	3.2	4.4
1941	3.3	4.3
1942	5.7	6.0
1943	7.2	9.0

Study of 240 factories in Tokyo, Kanagawa, Aichi, Osaka, Hyogo and Fukuoka prefectures: Ministry of Health and Social Affairs.

which dropped steadily during 1943 and 1944, was less than 50 percent by January 1945. Where dormitories were provided attendance was much better, due to more adequate food and lack of transportation problems. Attendance was also better in factories managed by the army and in those outside of the heavily-bombed areas "except that nutrition caused some absenteeism."

Food is a tremendous morale factor, particularly in countries where malnutrition is ever present and famine is a recurring phenomenon, as has been the case in Japan. Under such conditions, the existence of or fear of food shortages could be expected to lower the morale of industrial workers and to cause increased absenteeism and decreased production long before any considerable proportion of the workers developed significant manifestations of malnutrition. This is the most plausible explanation of the situation in Japan in 1943 and the early part of 1944. During the latter half of 1944 and during 1945, actual malnutrition assumed increasingly serious proportions. In the summer of 1944 the Institute of Public Health, through the government, recommended that factories reduce the workday from 11 to 9 hours, with one rest day per week, instead of every two weeks, because production was decreasing due to tuberculosis, colds, diarrhea and fatigue among the workers. Most factory managements ignored these recommendations.

Urban Salaried Workers

Dietary habit survey—A survey of the dietary habits of urban dwellers conducted by the Ministry of Health and Social Affairs in 1943 revealed:

(1) a reduction from 1942 in the number of local specialties consumed;

(2) an increase in the extent to which rice (the staple food) was mixed with substitutes such as barley, soybeans, potato flour, etc.;

(3) a decrease in the types of supplemental dishes, especially in animal food, fats and oils and fruits; and

(4) a decrease in the amount of eating between meals.

The results of the survey are not subject to precise quantitative analysis. Nevertheless, they indicate a definite reduction in civilian food supply and a deterioration of the civilian diet not readily apparent from figures for the official staple ration during this period.

Unique vulnerability—Even though their requirements were generally lower than those of factory workers, laborers, pregnant and nursing women and adolescents, the urban-salaried workers in Japan were among the first to be affected by shortages of food not included in the basic ration, as they did not receive the supplementary rations of rice and other cereals received by the other groups. Furthermore, the high wartime food prices and large black market induced particular hardships on the low-income, fixed-salaried, urban workers. Usually, manual workers will reduce their energy expenditure and their work output when their food consumption is decreased and thus protect themselves. Mental workers, rationed on the basis of minimum energy expenditure, would not find this device so effective.

Weight loss studies—The members of the Medical Division of the Survey found marked weight loss to be general among low-salaried government employees, university staffs and professional people interviewed during October and November 1945. A typical example was the chief chemist of the Tokyo Municipal Hygiene Laboratory, who lost 30 kilograms (66 pounds) during 1944–45. Among those who suffered most were hospital employees, always an unfavored group. Table 61 gives the average daily protein, fat and calorie values of the meals

served the nurses of the Aiiku Hospital, Tokyo, during June 1944. It is inconceivable that these nurses could have functioned efficiently on the meals they appear to have received.

TABLE 61.—*Average daily food consumption of nurses June 1944*

Source	Protein (grams)	Fat (grams)	Calories
From rice and other cereals	24.0	2.4	1,238
From all other foods	30.1	4.7	237
Protein from animal sources	(21.2)		
Total	54.1	7.1	1,475
Institute for Nutrition recommended allowance	75		2,200
Percent of recommendation obtained	72		67

Source: Aiiku Hospital, Tokyo.

There were no comprehensive data on the nutritional status of urban-salaried workers beyond the year 1943. In that year the Ministry of Health and Social Affairs collected the data given in the tables which appear later in this section. Between 1939 and 1943 gradual weight losses occurred, on the average, among primary school teachers, insurance company employees and employees of the government railroads (Table 63).

TABLE 62.—*Weight changes in salaried workers*

Type of worker	Sex	Age group (year)	Weight in 1939 (kilograms)	Weight in 1943 (kilograms)	Annual trend	Ratio 1943: 1939 (percent)
Primary school teachers [1]	Male	30–39	57.07	55.68	Gradual decreases	97.6
	Female	30–	49.42	48.41	do	98
Insurance employees [2]	Male	30–39	54.15	50.30	do	92.9
	Female	30–	48.94	45.89	do	93.8
Government railroad employees [3]	Male	30.39	54.86	52.84	do	96.3

[1] Districts of Sapporo, Sendai, Kanazawa, Tokyo, Nagoya, Osaka, Hiroshima and Fukuoka.
[2] Districts of Tokyo and Osaka.
[3] Districts of Sapporo, Sendai, Niigata, Tokyo, Nagoya, Osaka, Hiroshima and Moji.
Source: Ministry of Health and Social Affairs.

How much of the apparent weight loss was due to the drafting of the more able-bodied men by the military and the transference of both men and women to work in manufacturing plants was not determinable, but it cannot be doubted that reduced food consumption was an extremely important cause of the weight reduction observed.

Comparison of Table 62 with Table 59 in the preceding section shows that the weight reduction among insurance company and government railroad employees was much greater than that observed in factory workers between 1939 and 1942. It is important to note, however, that the school teachers, salaried employees of insurance companies and the government railroad employees were better nourished in 1939 than the factory workers and, presumably, could afford larger weight losses.

Associated diseases—The incidence of tuberculosis among primary school teachers increased appreciably in 1938 and again in 1942 (Table 63). Substantial increases in the incidence of tuberculosis also were observed every year from 1938 to 1942 among employees of the government railroads (Table 64). Similarly, among employees of the Communications Ministry, tuberculosis increased markedly in 1939, 1940 and 1942 (Table 65). Practically concomitant with the increasing incidence of tuberculosis was an increasing incidence of gastrointestinal disease and beriberi among employees of both the government railroads and

TABLE 63.—*Incidence of tuberculosis, gastrointestinal diseases and beriberi in primary school teachers, 1936–1942*

Year	Number of persons examined	Tuberculosis		Gastrointestinal disease		Beriberi	
		Number of cases	Rate per 1,000	Number of cases	Rate per 1,000	Number of cases	Rate per 1,000
1936	10,002	205	20.5	130	13.0	25	2.5
1937	10,449	208	19.9	136	13.0	21	2.0
1938	8,693	257	29.6	136	15.6	21	2.4
1939	11,400	271	23.8	131	11.5	28	2.5
1940	10,869	300	27.6	146	13.4	29	2.7
1941	11,829	346	29.3	118	10.0	29	2.5
1942	12,215	582	47.6	154	12.6	46	3.8

Source: Ministry of Health and Social Affairs studies in the cities of Osaka, Nagoya, Fukuoka and Hiroshima.

TABLE 64.—*Incidence of tuberculosis, gastrointestinal diseases and beriberi, urban employees of government railroads, 1936–42*

Year	Tuberculosis		Gastrointestinal disease		Beriberi	
	Number of cases	Rate per 1,000	Number of cases	Rate per 1,000	Number of cases	Rate per 1,000
1936	4,309	18.9	4,538	20.7	698	2.6
1937	4,558	18.2	5,125	20.4	764	3.0
1938	5,525	20.7	6,302	23.5	1,374	5.1
1939	7,366	23.9	8,193	26.6	1,447	4.7
1940	10,712	31.9	10,940	32.7	1,771	5.3
1941	13,704	36.9	11,600	31.3	2,133	6.3
1942	16,423	42.9	13,477	35.2	3,558	9.3

Source: Ministry of Health and Social Affairs.

TABLE 65.—*Incidence of tuberculosis, gastrointestinal disease and beriberi, urban employees of Communications Ministry, 1933–1942*

Year	Tuberculosis		Gastrointestinal disease		Beriberi	
	Number of cases	Rate per 1,000	Number of cases	Rate per 1,000	Number of cases	Rate per 1,000
1933	1,715	20.9	1,621	19.8	441	5.4
1934	2,007	23.8	1,759	20.8	426	5.0
1935	3,197	36.6	1,863	21.3	408	4.7
1936	2,457	26.6	1,919	20.8	430	4.7
1937	2,063	22.3	2,046	22.1	400	4.3
1938	2,277	23.0	2,416	24.4	609	6.2
1939	2,910	27.0	3,466	32.2	781	7.2
1940	3,751	31.5	4,024	33.8	820	6.9
1941	5,212	40.2	4,031	31.1	1,040	8.0
1942	12,439	60.7	9,587	46.8	2,585	12.6

Source: Ministry of Health and Social Affairs.

the Communications Ministry. Beriberi increased sharply in 1942 among all three groups of salaried workers.

The upward trend in the incidence of tuberculosis, gastrointestinal disease, and beriberi that began in about 1938 seems to have been due partly to the loss of healthy men to the armed services and conscripted labor units, with a resultant increase in the number of unfit people employed. However, this is an indication of the general poor state of health and nutrition of the Japanese people. The marked increase in the incidence of these diseases in 1942 was undoubtedly due primarily to malnutrition resulting from the restricted wartime food situation.

Pregnant Women, Nursing Mothers, Infants and Children

Food consumption by various population groups has been discussed in a previous section on food supplies. Except for a description of the food situation in one maternity hospital, presented as an illustration of general conditions, this section is limited largely to a discussion of the changes which occurred during the war in the health and nutritional status of infants and children under 12 years of age.

Maternity hospital diets — Appendix B–8 gives the recommendations of the Japanese Institute for Nutrition on the calorie and protein requirements of pregnant and nursing mothers and children up to the age of 12 years. Table 66 indicates the results of an analysis of the diets of pregnant women hospitalized in the Aiiku Hospital, Tokyo during the years 1941 to 1945. The caloric value of the hospital diet decreased in 1943 and the protein content decreased in 1944. Beginning in June 1945 all patients were required to furnish their own rations of rice and Miso (Bean paste).

The distribution of fruits to Tokyo hospitals began to drop off in 1941 and the Aiiku Hospital did not receive any fruits after the middle of 1943. The hospital was compelled to use radish and turnip juices, extracts of mulberry and persimmon leaves, and the juices from green vegetables and grasses as sources of vitamin C for bottle-fed infants and sick children.

Supply of cow's milk—The distribution of cow's milk was inadequate in 1943 and an acute decrease in the supply suddenly occurred in August 1944. Even the official restriction of distribution to mothers and infants to physicians' prescription failed to insure the supply to these special groups and, as a result, the Aiiku Hospital as did others, resorted to substitutes made of grain, peanuts, soybeans, butter and sugar. In 1945 even these materials became extremely scarce.

Weight losses in pregnant women—According to a survey by the Ministry of Health and Social Affairs, 84 percent of pregnant women in large cities in 1943 considered their rice ration to be insufficient, an increase of 14 percent over 1942. In medium or small cities 92 percent of pregnant women reported the rice ration inadequate, an increase of 11 percent in such reports over 1942. Seventy-eight percent of the pregnant women in rural areas regarded the ration to be insufficient, a 10 percent increase in such complaints over that of 1942.

Under these conditions, one might expect deterioration of the nutritional status of pregnant women, nursing mothers, infants and children. Actually this did occur, but had not reached an alarming state by November 1945. During the last years of the war the body weights of pregnant women, in the large cities decreased slightly. The records of the Aiiku Research Institute, Tokyo for the year of 1944 show an average weight of 53.04 kilograms for women in their first pregnancy, and an average weight of 52.87 kilograms for women in their second or later pregnancy. These comprise decreases of 1.12 kilograms (2.46 lb) and 0.79 kilograms (1.74 lb), respectively, from the average weights of like groups of pregnant women in the same hospital in 1943. Data obtained from the Min-

TABLE 66.—*Analysis of the diets of pregnant women, 1941–45*

Month	Protein (grams)					Fat (grams)					Calories				
	1941	1942	1943	1944	1945	1941	1942	1943	1944	1945	1941	1942	1943	1944	1945
January	32.3	37.6	32.7	27.5	28.6	17.4	17.3	16.3	15.7	8.5	543	482	425	333	301
February	29.9	36.7	33.4	26.9	28.1	15.8	16.4	16.4	16.1	7.9	508	489	419	342	326
March	32.6	38.2	32.5	25.8	30.8	15.1	17.5	15.6	14.7	8.1	505	441	417	336	297
April	35.3	37.2	33.4	25.9	(1)	16.4	16.0	17.2	16.1	(1)	512	439	416	337	(1)
May	34.9	37.8	34.4	23.7	(1)	15.2	14.5	18.1	16.8	(1)	478	437	438	332	(1)
June	36.0	36.5	(1)	25.4	11.8	16.3	15.5	(1)	17.3	3.7	486	440	(1)	342	617
July	34.1	36.8	34.4	28.5	10.0	19.0	15.6	16.7	16.9	2.7	482	447	432	372	233
August	34.4	36.7	32.9	48.1	4.3	16.9	16.8	15.6	20.4	2.5	497	471	432	553	122
September	34.6	36.2	33.2	34.3	10.6	18.9	14.9	15.3	15.3	3.4	488	467	432	415	159
October	36.3	32.6	32.8	21.5	14.2	17.4	15.5	14.4	9.7	6.9	499	458	424	282	209
November	36.6	32.2	29.8	20.6	(1)	16.8	17.3	15.7	12.7	(1)	503	473	403	304	(1)
December	36.5	33.2	27.8	25.8	(1)	17.0	16.0	15.0	11.1	(1)	490	460	355	300	(1)
Average	34.5	36.0	32.5	27.8	17.3	16.8	16.1	16.0	15.2	5.5	499	459	418	354	283
Additional from rice	23.1	23.1	23.1	23.1	21.0	2.6	2.6	2.6	2.6	2.4	1,155	1,155	1,155	1,155	1,050
Total	57.6	59.1	55.6	50.9	38.3	19.4	18.7	18.6	17.8	7.9	1,654	1,614	1,573	1,509	1,333

[1]—values not available.
Source: Aiiku Hospital, Tokyo.

istry of Welfare show no significant variations from 1937 to 1943 in Tokyo except for a high average in 1939 (55.04 kilograms). The average weight in 1943 was 54.30 kilograms. The lowest average was 54.28 kilograms in 1940.

Birth weights—Statistics of the Ministry of Health and Social Affairs (Survey of the Present Nutritional Condition of the Nation, 31 December 1943) do not indicate any deleterious effect of war conditions upon the birth weights of babies born in Tokyo during the war up to and including 1943. In contrast, the statistics

TABLE 67.—*Birth weight, average*

[Grams]

Year	Tokyo		Osaka	
	Male	Female	Male	Female
1936	2,920	2,850	2,950	2,860
1937	3,000	2,930	2,940	2,910
1938	2,930	2,880	2,890	2,880
1939	2,940	2,870	2,920	2,850
1940	2,920	2,840	2,910	2,830
1941	2,930	2,860	2,940	2,850
1942	2,960	2,860	2,940	2,810
1943	2,970	2,860	2,850	2,790

on the city of Osaka (Table 67) show some decline in the birth weight of females in 1942 and 1943, and a substantial decrease in the birth weight of males in 1943. The average birth weights for the cities of Tokyo, Osaka, Nagoya and Kyoto, as compiled by the Aiiku Research Institute for the periods 1938–39 and 1943–44, are shown in Table 68. The birth weight of first-born females was less in 1943–44 than in 1938–39. This was also true of the weights of both males and females born to mothers who had had from one to three children previously. Records of the birth weights of children born

TABLE 68.—*Average birth weights in cities*

[Grams]

Year	First born		Second to fourth child		Fifth child or over	
	Male	Female	Male	Female	Male	Female
1938–39	2,830	2,786	2,981	2,934	2,972	2,890
1943–44	2,811	2,753	2,954	2,884	3,006	2,864
Difference	—19	[1] —33	[1] —27	[1] —50	+34	—26

[1] Statistically significant difference.
Source: Aiiku Research Institute for Tokyo, Osaka, Nagoya and Kyoto.

in the hospital of the Aiiku Research Institute from 1941 to 1944 show a decrease in birth weights for 1944 (Table 69). According to the director of the Aiiku Research Institute, decreased birth weights were not observed in medium-sized cities such as Kanagawa, Sendai, Sappora, Niigata and Fukuoka through 1944.

TABLE 69.—*Weight of the newborn*

[Grams]

Year	Males			Females			Total		
	Number of cases	Mean weight	Standard deviation	Number of cases	Mean weight	Standard deviation	Number of cases	Mean weight	Standard deviation
1941	46	3,030.2	50.619	62	2,887.9	51.575	108	2,948.5	37.250
1942	152	2,937.1	40.482	128	2,943.5	37.060	280	2,940.0	27.754
1943	197	2,948.2	29.716	161	2,850.9	29.356	358	2,904.4	21,172
1944	65	2,841.6	43,178	68	2,832.8	50.291	133	2,837.1	33.270

Decline in breast feeding—Normally the majority of infants in Japan are breast-fed. A study conducted by the Institute of Public Health in an industrial district of Tokyo in 1936–37, showed that 75.1 percent were partially breast-fed and 2.0 percent were artificially fed.

During the war there was decrease in the proportion of infants entirely breast-fed. Of 1,800 infants brought to the out-patient clinic of the Aiiku Hospital in Tokyo from 1940 to 1943, 62.1 percent were entirely breast-fed, while only 49.1 percent of 250 infants in that clinic during the first half of the year 1944 were entirely breast-fed. The decrease in breast feeding is illustrated by figures from the Homada Hospital, Tokyo shown in Table 70. The

TABLE 70.—*Percentage of infants breast-fed, Homada Hospital, Tokyo*

Year	Week of life	
	First (percent)	Second (percent)
1936	86	81
1937	86	74
1938	84	75
1939	76	66
1940	73	67
1941	71	60
1942	68	70
1943	73	67
1944	77	65

consistent policy of the medical staff of the Homada Hospital has been one of not weaning infants unless absolutely necessary. The figures in Table 70 therefore indicate the prevalence of inadequate maternal lactation. Failure of lactation was more pronounced during the second week of the infant's life when milk requirements were greater.

Maternal lactation—Among women in the large cities the quality of mothers' milk, as well as the quantity, appears to have deteriorated during the last years of the war. Analyses of mothers' milk in Tokyo and Osaka prior to 1942 showed average values for fat of 3.26 percent; for lactose, 7.27 percent; and for protein, 1.23 percent. Analyses in the same cities in 1943 revealed values for fat of 3.06 percent; for lactose, 7.20 percent; and for protein, 1.08 percent.

In rural areas the changes in the quality and quantity of mothers' milk appear to have been less marked up to 1943. Analyses made that year in seven predominantly rural prefectures (Ishikawa, Yamanashi, Kukushima, Aomori, Kumamoto, Ehime and Okayama) showed average analyses of 3.31 percent fat; 7.28 percent lactose, and 1.097 percent protein. Data from the Kumamoto prefecture showed that in 1944, 17.9 percent of 53,110 mothers were unable to nurse their infants adequately. In July 1945 the proportion of mothers unable to nurse their infants adequately had increased to 20.13 percent of 1,962 mothers examined. The two chief causes recorded for poor and nonlactation during 1944 and 1945 were overwork (24.2 and 28.6 percent) and malnutrition (34.7 and 31.65 percent).

Maternal malnutrition—The Ministry of Health and Social Affairs conducted a survey of 9,791 pregnant women from 30 October to 23 December 1943 and compared the results with those of a like survey made during the same months of 1942. As the records for these studies were not obtained from physicians, but from the women themselves, the results cannot be considered too reliable. The findings were that in 1943, 12 percent of pregnant women in large, medium and small cities and 9 percent of those in rural areas had beriberi, an increase of about three percent over 1942. However, the incidence of pulmonary tuberculosis, kidney disease, diarrhea and enteritis, and night blindness was small, with no marked increase over 1942.

Physicians of the Aiiku Research Institute examined the pregnant women in a small village in Yamanashi prefecture in April 1944, and continued their examinations in a village in Kanagawa prefecture in May 1944. Only six of the 60 women examined were considered normal. Approximately 65 percent of the total number were found to be afflicted with hypertension (30 percent), varicose veins (21.66 percent), edema (6.66 percent) or beriberi (6.66 percent). Beriberi is known to be caused by dietary deficiency, and the other conditions are found most commonly in association with malnutrition and overwork. No results of examinations of these women for nutritional status were recorded.

Abortions, stillbirths and premature births—The incidence of noninduced abortions, stillbirths and premature births is another measure of the health of pregnant women. However, the annual incidence record for Japan is not accurate. Although since 1942 all pregnant women have been required to register for examination, they generally do not do so until about the fifth month of pregnancy. Most verifications of pregnancy are registered at the time of examination and thus many abortions occurring prior to the fifth month of pregnancy are not re-

corded. The figure of 2.25 percent (4,389 out of 195,232 pregnancies) for the rate of abortions and stillbirths in Tokyo from April 1943 to March 1944, although probably too low, compared favorably with the 1936–37 rate of 2.3 percent reported by the Institute of Public Health for an industrial district of Tokyo.

A cooperative investigation by physicians and midwives revealed that the incidence of abortions and stillbirths in 31,759 pregnancies in Kumamoto prefecture in 1944, was 10.5 percent (abortion, 6.9 percent and stillbirths, 3.6 percent). The incidence of premature births, not including stillbirths, was 2.4 percent. The results of investigations made in 17 villages for the years 1933–42 are shown in Table 71.

TABLE 71.—*Incidence of premature births, abortions and stillbirths in 17 Japanese villages*

[Percent of total pregnancies]

Year	Premature birth (percent)	Abortion (percent)	Stillbirths (percent)	Total (percent)
1933	1.7	1.6	1.0	4.3
1935	1.6	2.2	1.4	5.2
1937	1.6	2.3	1.6	5.5
1939	1.9	2.4	1.7	6.0
1940	2.2	2.9	1.8	6.9
1941	2.8	3.3	1.6	7.7
1942	2.3	3.9	1.9	8.1

Source: Aiiku Research Institute, Tokyo, Japan.

Apparently there was a progressive increase in the abortion rate from 1939 to 1942. The reason advanced for this by the Japanese physicians interrogated was the increasing extent to which rural women were compelled to engage in heavy outdoor work because of the lack of male labor. Of 2,199 abortions and 758 premature births, exclusive of stillbirths, in Kumamoto prefecture in 1944, the physicians or midwives in charge considered 43.4 percent to be due to overwork of the mothers. Presumably the factor of overwork was of much less importance as a cause of abortions and premature births in the large cities judging by the low 1943–44 incidence of these in Tokyo. Wartime malnutrition does not appear to have been important as a cause of premature births, abortions and stillbirths.

Infant mortality—The infant mortality rate decreased from 1931 to 1941, and in the latter year, reached the lowest level ever recorded in Japan—84.1 deaths for each 1,000 births. From 1941 to 1943, the last year for which records were obtainable, the rate increased from 84.1 to 86.6, but was still below the 1940 level of 90.0 deaths for each 1,000 births. The average infant mortality rate of the six principal cities (Tokyo, Osaka, Nagoya, Kyoto, Kobe and Yokohama) showed a low point of 67.6 deaths for each 1,000 births in 1940, with a slight rise in 1941 to 69.9 and a sharp upturn in 1943 to 75.4 deaths for each 1,000 births. Although the 1943 infant mortality rate for the six large cities was considerably lower than the lowest rate ever recorded for the country as a whole, it indicated the incipient deterioration of maternal and infant health.

Infant malnutrition—In 1943, government health examinations were given to 3,179,086 infants, or 86.1 percent of all infants under two years of age in Japan. Of this number, 398,316 (12.53 percent) were found to be ill-nourished and poorly developed. An additional 277,061 (8.72 percent) were suffering from diseases. Two predominantly rural prefectures, Toyama and Fukui (the rickets region of Japan) showed the highest incidences of infant abnormality and disease, 36.52 percent and 36.10 percent, respectively.

No recent national investigation of the causes of infant mortality have been made, but in 1944 Professor Taniguchi examined 921 infants and 1,175 children from 2 to 5 years of age in the Kumamoto prefecture. His findings regarding the principal causes of mortality are given in

TABLE 72.—*Causes of mortality of infants and children, Kumamoto Prefecture, 1944*

Disease	Infants		Children	
	Number	Percent	Number	Percent
Diarrhea and enteritis (including malnutrition)	188	20.4	367	31.3
Debility	209	22.7	5	0.4
Whooping cough	46	5.0	51	4.3
Pneumonia	216	23.5	280	23.8
Encephalitis and meningitis	30	3.3	53	4.5
Dysentery	19	2.1	119	10.1
Septicemia	28	3.0	23	2.0
Measles	17	1.8	64	5.4
Congenital syphilis	16	1.7	4	0.4
Beriberi	18	2.0	2	0.2
Diphtheria	3	0.3	27	2.3
Nephritis	1	0.1	37	3.1
All other causes and unknown	130	14.1	143	12.2
Total	921	100	1,175	100

Note. Children in this study were all less than 5 years of age.

Table 72 but it is not possible to determine precisely from this the proportion of deaths due primarily to malnutrition. However, malnutrition undoubtedly played an important role—in many cases the major role—in the etiology and

course of those diseases described as diarrhea and enteritis (including malnutrition), debility and beriberi. These four conditions accounted for 45 percent of the deaths of infants and 31.8 percent of the deaths among children from 2 to 5 years of age.

More evidence of malnutrition was found in August 1944, when physicians from the Aiiku Research Institute determined the body weight of 76 children from birth to five years of age in a village in Yamanashi prefecture. Fifty-six of the children were 20 percent or more below the standard, and 19 children, or 25 percent, were from 10 to 20 percent below the standard.

Growth-rate of children—The Ministry of Health and Social Affairs in its study of the nutritional condition of the nation, published in December 1943, compared the rate of growth of school children who had reached the age of 12 years in 1943 with the rate of those who had attained that age in 1936. Twelve-year-old boys in 1943 averaged 2.3 centimeters less in height and 1.2 kilograms less in weight than did boys of the same age in 1936. Twelve-year-old girls averaged about 1.0 centimeters less in height and 1.8 kilograms less in weight in 1943 than in 1936. The results of the study, broken down according to district, period and age are given in Table 73 and are illustrated in Figure 12. In the country as a whole, a decreased rate of growth appears to have occurred as early as 1941 for school girls living in industrial and urban residential districts and as early as 1942 for both boys and girls living in these districts.

An increase in malnutrition, as evidenced by the decreased growth-rate of school children, did not develop in agricultural districts between the year 1938 and the end of 1943. It is pertinent to note, however, that in both the 1931–36 and 1938–43 periods, and at each age, 7- to 12-year-old girls and boys residing in agricultural districts averaged less in both height and weight than their counterparts in industrial and urban residential districts. By the end of 1943, however, the weights of urban boys and girls of 12 years of age had decreased to about the level of country children of the same age. The proportion of school children classified as of "fair" nutritional status (92 percent) and as "care essential" (8 percent) by examining physicians in 1943 was the same in city and country.

School lunch inadequacy—A Ministry of Health and Social Affairs appraisal of the "side dishes"—foods used to supplement the staple cereal ration brought to school for lunches—in 1943, resulted in the following evaluation:

The proportion of side dishes classified "poor" in 1943 increased 8 percent over the proportion in that category in 1942, principally at the expense of the "fair" category. In 1943, 99 percent of urban children and 65 percent of rural children ate no rice (cereal) except that obtained on the ration. Only 3.5 percent of urban children and 17 percent of country children thought that they got enough to eat. In 1942, 29 percent of urban children and 50 percent of rural children had felt that they received

TABLE 73.—*Average height and weight of children throughout Japan*

Type of district	Age Age (years)	Height (centimeters)				Weight (killograms)			
		1938–43		1931–36		1938–43		1931–36	
		Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
Industrial	7	110.65	108.98	109.26	108.26	18.68	18.14	17.16	17.39
	8	115.78	114.42	114.64	113.39	20.56	19.96	20.16	19.43
	9	120.58	119.15	119.53	118.18	22.68	21.95	22.17	21.53
	10	125.16	124.15	124.57	123.29	24.23	23.81	24.65	23.98
	11	129.08	128.31	129.23	128.13	26.22	26.28	26.92	26.80
	12	133.15	133.42	134.06	133.74	28.97	29.08	29.22	30.12
	12½	135.35	135.98			29.93	30.63		
Residential and business	7	110.62	109.26	109.37	108.14	18.71	18.07	18.00	17.59
	8	115.88	114.31	114.82	113.33	20.61	19.90	20.06	19.46
	9	121.03	119.42	120.00	118.66	22.60	21.82	22.09	21.64
	10	124.79	124.31	124.02	123.38	24.74	23.86	24.38	23.98
	11	129.77	128.45	129.49	128.60	26.75	26.07	26.81	26.61
	12	133.69	133.58	133.99	134.28	29.29	29.02	29.60	29.96
	12½	136.37	136.89			30.34	30.55		
Agricultural and fishing	7	108.88	107.69	108.13	107.11	18.32	17.65	18.04	17.25
	8	114.32	112.87	113.47	112.27	20.32	19.55	19.88	19.01
	9	119.26	118.19	118.25	116.71	22.26	21.58	21.94	21.00
	10	124.02	123.77	123.06	121.72	24.62	23.93	24.18	23.19
	11	128.36	127.42	127.55	126.21	26.53	25.99	26.37	25.56
	12	132.57	132.69	132.14	131.98	29.17	29.26	29.05	28.65
	12½	135.00	135.64			30.60	31.08		

GROWTH CURVE IN SCHOOL CHILDREN

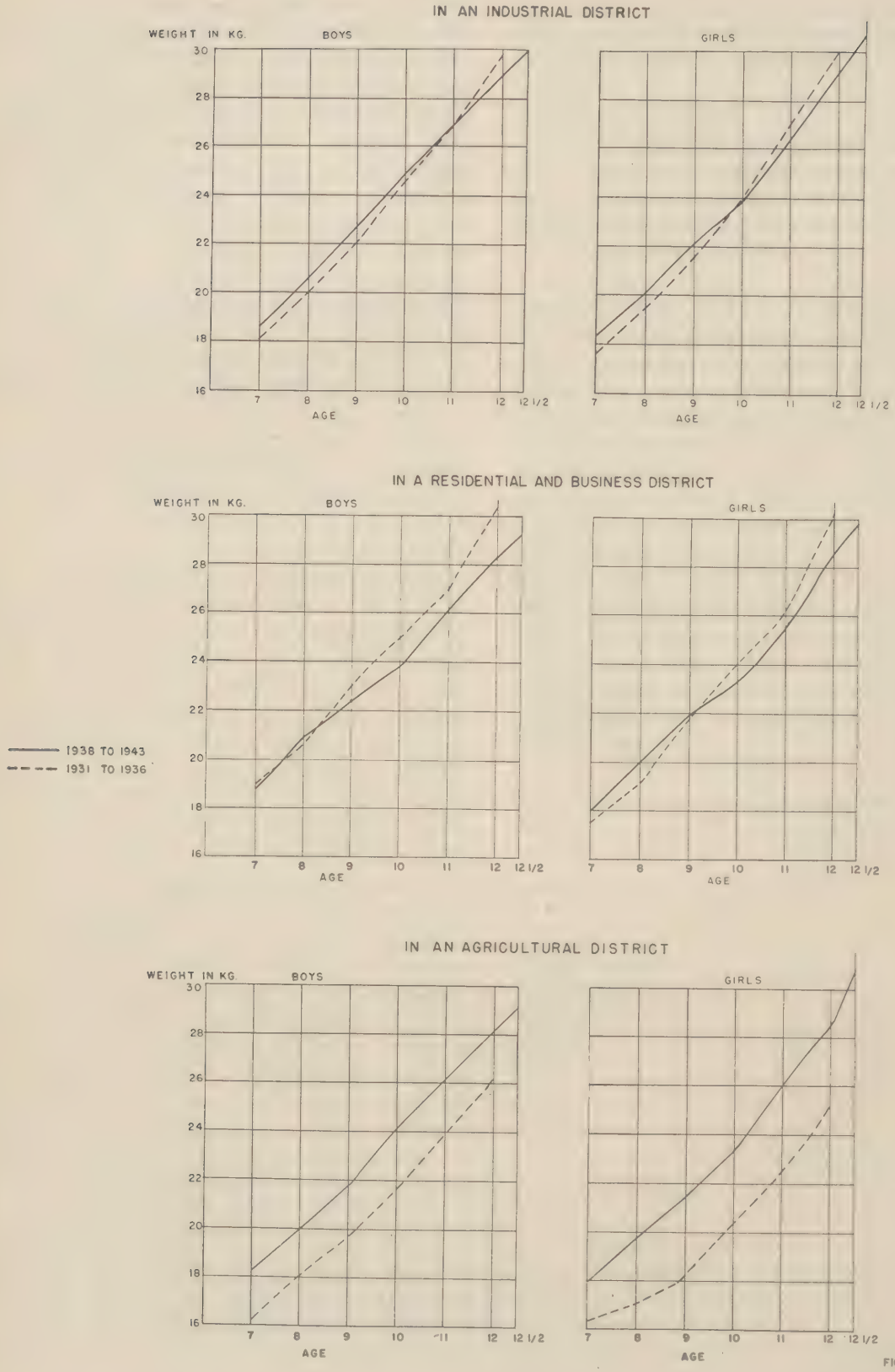


FIGURE 12

TABLE 74.—*Diseases attributed to malnutrition reported to have increased in incidence during the war years*

Medical district	War edema	Beriberi	Diarrhea	Failure of maternal lactation	Digestive disorders of infants	Under-nutrition of infants and children	Scurvy	Night-blindness	Skin diseases	Conjunctivitis	Catarrhal jaundice
Tokai district (Shizuoka, Aichi, Gifu, Mie)	+	+	+								+
Hikuriku district (Toyama, Ishikawa, Fukui)	+	+	+	+	+			+		+	+
Kinki district (Shiga, Hyogo, Kyoto, Nara, Osaka, Wakayama)	+	+	+	+		+			+		+
Chugoku district (Tottori, Shimane, Okayama, Hiroshima, Yamaguchi)		+				+		+			+
Shikoku district (Tokushima, Kagawa, Ehime, Kochi)	+	+		+				+			+
Kyushu district (Fukuoka, Saga, Nagasaki, Oita, Kumamoto, Miyazaki, Kagoshima)	+	+		+		+		+			+
Hokkaido district (Hokkaido)		+		+	+		+		+	+	
Tohoku district (Aomori, Iwate, Miyagi, Akita, Yamagata, Fukushima)	+	+	+	+	+			+			
Kanto district (Ibaraki, Tochigi, Gumma, Saitama, Chiba, Kanagawa)	+		+					+	+	+	+
Shinetsu district (Nijgata, Nagano, Yamanashi)		+									

Source: Reports of the district physicians' associations to the Physicians' Association of Japan, 30 Sept. 1945.

enough to eat.

Incidence and Types of Nutritional Deficiency Diseases

Associated diseases—In September 1945, the district physicians' associations were requested to report to the Physicians' Association of Japan all those diseases which had increased in incidence during the war years. Table 74 lists the diseases the Japanese physicians attributed to malnutrition and reported as having increased in incidence in one or more districts during the war. The list is seriously at fault, not only because the actual incidence of the various conditions is not given, but especially because the most prevalent and economically most important manifestations of malnutrition have been omitted.

The apathy, disinclination to work, lessened endurance and decreased resistance to diseases such as tuberculosis that develop in undernourished individuals long before frank deficiency diseases become manifest are the conditions that should be of primary concern to a country struggling to maintain civilian morale and productivity during a major war. This lack of well-being, generally accompanied by loss of weight, some degree of nutritional anemia and minor evidences of vitamin deficiencies, is always of far greater prevalence than the incidence of any one classical deficiency disease or of all of them combined.

Due to the curtailment of the food supply and the inequities in food distribution, discussed in previous sections, it is obvious that the majority of civilians in Japan were inadequately nourished from a caloric standpoint during 1945. The individuals adversely affected included practically all the residents of the large and medium-sized cities. In November 1945, Dr. Iizuka of Kyoto Imperial University estimated that 100 percent of the adult population of the city of Kyoto, an unbombed area, had lost 10 pounds in weight, that 65 percent had lost 20 pounds in weight, and that 33 percent had lost 30 pounds in weight.

Effect on bomb casualties—Japanese physicians who had treated bomb casualties, in Nagasaki and Hiroshima as elswhere, were of the opinion that many of the delayed deaths would not have occurred had the victims been better nourished prior to their injury or had it been possible to feed them properly after the injury. The nutritional status and health record of rural people appears actually to have improved, on the average during the war, probably surpassing that of urban residents in 1944 and 1945 and certainly surpassing that of people

residing in bombed areas.

Decline in military rations — Confirmatory evidence of the adverse food situation was obtained from the records of the Japanese Army and Navy. One expects a militaristic nation engaged in a life and death struggle to feed its armed forces adequately as long as this is possible and yet Japan found it necessary to reduce the rations of the Army and Navy in the Home Islands in 1944. The Navy was able to supply a ration amounting to 3,500 calories per man per day until October 1944. At this time the ration was reduced to the equivalent of 3,100 calories, with additional amounts for those undergoing initial training, however, the food actually obtained supplied only 2,400 to 2,700 calories, or 77 to 87 percent of the official ration. In September 1944, the Army reduced the rations for soldiers stationed on the Home Islands from 3,400 calories to 2,900 calories per man, the actual food supplied daily averaging about 2,800 calories. This was done even though the Imperial Headquarters believed 3,200 calories to be the minimum requirement of a soldier.

Malnutrition in the armed forces—Up until the time of the ration decrease, it had been the rule for the weight of the soldier to increase by about 2 kilograms in the first 4 months after conscription. After the ration was decreased, not only was there no initial weight gain by the new soldier but in some cases marked emaciation, diarrhea, and other symptoms of malnutrition developed. According to Lt. Col. Hiraga of Imperial General Headquarters, the number of such cases totaled about 10,000, with 100 deaths. Prior to the war the average weight of Japanese soldiers was 60 kilograms; in May 1945 it was 54 kilograms.

According to the director of the Japanese Imperial Government Institute for Nutrition Research, about 50 percent of hospitalized military personnel were suffering from malnutrition at the time of the surrender. Although many of the patients with malnutrition had no other disease, most of them also had malaria or dysentery. The signs of malnutrition observed include edema, emaciation, nervousness, diarrhea, atrophy of the skin with greenish-white discoloration, cold hands and feet, protruding stomach, ataxia, apathy and general sluggishness, anemia, respiratory difficulty, slurred speech, slow pulse, reduced systolic blood pressure and masklike face. Classical deficiency diseases such as beriberi and pellagra were of insignificant occurrence.

Six thousand cases of severe malnutrition were admitted to naval hospitals from October 1944 to November 1945, and accounted for 20 percent of the total hospital admissions during that period, according to Sadamu Nagato, surgeon in charge of the Tokyo Naval Hospital. Beriberi was not of great concern to the Navy, as it accounted for only 15 percent of all the malnutrition cases in naval hospitals.

Commander Nagato stated that in May 1945 he had examined 417 students at the naval college in Maizuru and found malnutrition in 30 percent of them, 10 percent having beriberi. At the time of the examination, these students were actively engaged in the full training course given by the college.

Symptoms of malnutrition—The following discussion of the disease conditions listed in Table 74 covers only the more severe manifestations of malnutrition observed in Japan during the war.

"War edema"

"War edema" never occurred as an isolated manifestation of malnutrition but always as a part of a general condition termed simply "malnutrition" by most Japanese physicians and frequently called "war sickness" by the laity. The symptoms generally recognized by Japanese physicians were apathy, fatigue, heaviness of the extremities, loss of desire for work and a decrease in voluntary body activity, cardiac palpitation and shortness of breath on exertion, hunger, neurasthenia and other mental disturbances, chilliness, cold extremities and decrease in sexual desire. The signs observed included loss of weight, loss of subcutaneous fat, anemia, edema, diarrhea, pale, dry, loose and desquamating skin, impaired digestion and absorption of foods, low systolic blood pressure, slow heart rate, decrease in the protein content of the blood, subnormal temperature and an increased erythrocyte sedimentation rate. Generally the neurological status remained normal.

The incidence and severity of "malnutrition" among civilian hospital patients increased greatly during 1944 and 1945. During the first nine months of 1945 the mortality rate of patients in the Tokyo psychopathic hospitals was 33 percent in contrast to a pre-war mortality

TABLE 75.—*Relation of sex and age to the occurrence of "malnutrition" observed in the polycliinc of Kyoto Imperial University*

[August 1942 to October 1945]

Age	Males			Females			Total male and female		
	Cases of malnutrition	Total new patients	Percent	Cases of malnutrition	Total new patients	Percent	Cases of malnutrition	Total new patients	Percent
15 to 19	29	945	3.1	17	616	2.8	46	1,561	2.9
20 to 29	27	1,297	2.1	24	1,111	2.2	51	2,408	2.1
30 to 39	59	1,253	4.7	30	731	4.1	89	1,984	4.5
40 to 49	79	1,034	7.6	34	481	7.1	113	1,515	7.5
50 to 59	64	728	8.8	27	377	7.2	91	1,105	8.2
60 to 69	33	408	8.1	7	193	3.6	40	601	6.7
Over 69	13	96	13.5	1	55	1.8	14	151	9.3
Total	304	5,761	5.3	140	3,564	3.9	444	9,325	4.8

TABLE 76.—*Relation between occupation and "malnutrition" observed in the polyclinic of the Kyoto Imperial University*

August–October 1945]

Occupation	Cases of malnutrition	Total of new patients	Percent
Workmen	120	1,374	8.7
Farmers, fishermen	9	770	1.2
Merchants	26	666	3.9
Students	34	876	3.9
Salaried men	90	1,254	7.2
Unemployed persons	117	1,564	7.5
Other occupations	48	2,821	1.7
Total	444	9,325	4.8

rate of five to eight percent. The assistant superintendent of Matsuzawa Psychopathic Hospital attributes this increase in the mortality rate to malnutrition. The food supply became progressively worse until, in September 1945, the patients each received an average of only 1,200 calories daily.

The changes from 1942 to 1945 in the ratio of patients with "malnutrition" to the total number of patients in the hospital of the Kyoto Imperial University are shown in Figure 13. The incidence of "malnutrition" was definitely higher in 1944 and 1945 than in 1942 and 1943 and the increase during the winter of 1944–45 was outstanding. It was more prevalent among men than among women, among people over 40 years of age and among laborers, salaried men, and unemployed persons than among other occupational groups (Tables 75 and 76).

Edema

According to the director of the First Medical Division of the Kyoto Imperial University Hospital, 80 percent of the hospitalized patients with "malnutrition" had some degree of edema. The district physicians' associations reported that "war edema" increased in incidence during 1944 and 1945 in seven of the ten medical districts into which Japan proper is divided by the Physicians' Association of Japan (Table 74). This is a reliable indication of widespread, serious malnutrition. The only actual figures that could be obtained on the incidence of "war edema" among non-hospitalized ambulatory individuals are given in Tables 77, 78 and 79. During the first 9 months of 1945, about 8 out of every 1,000 out-patients at the Keio University Medical School clinic in Tokyo had "war edema." The incidence in the general population of Tokyo may have been greater as this clinic, in common with the great majority of hospitals and clinics in Japan, catered to the few persons who were able to pay for services rendered and had relatively few charity cases.

The rise in the incidence of both "war edema" and beriberi that occurred in August and September could not be explained as a seasonal phenomenon, as could the relatively high rates for "war edema" during the winter months and for beriberi during April and May. It was, at least in part, a result of the deterioration in food distribution that occurred in Tokyo, during the summer of 1945, because of strategic bombing.

Information on the age, sex and occupational distribution of the total number of persons treated at the Keio University clinic from January to September 1945 was not obtained. Therefore, the actual incidence of "war edema" and of beriberi in those groups could not be determined. However, the data in Table 78 indicate that "war edema" showed a greater predilection for men, individuals over 40 years of age and office workers than did beriberi. Fifty percent of the patients with beriberi were under 30 years of age, while only 7.2 percent of the patients with "war edema" fell into this age group.

THE MONTHLY INCIDENCE OF "MALNUTRITION" OBSERVED IN THE POLYCLINIC OF THE FIRST MEDICAL DIVISION OF KYOTO IMPERIAL UNIVERSITY FROM AUGUST 1942 TO OCTOBER 1945

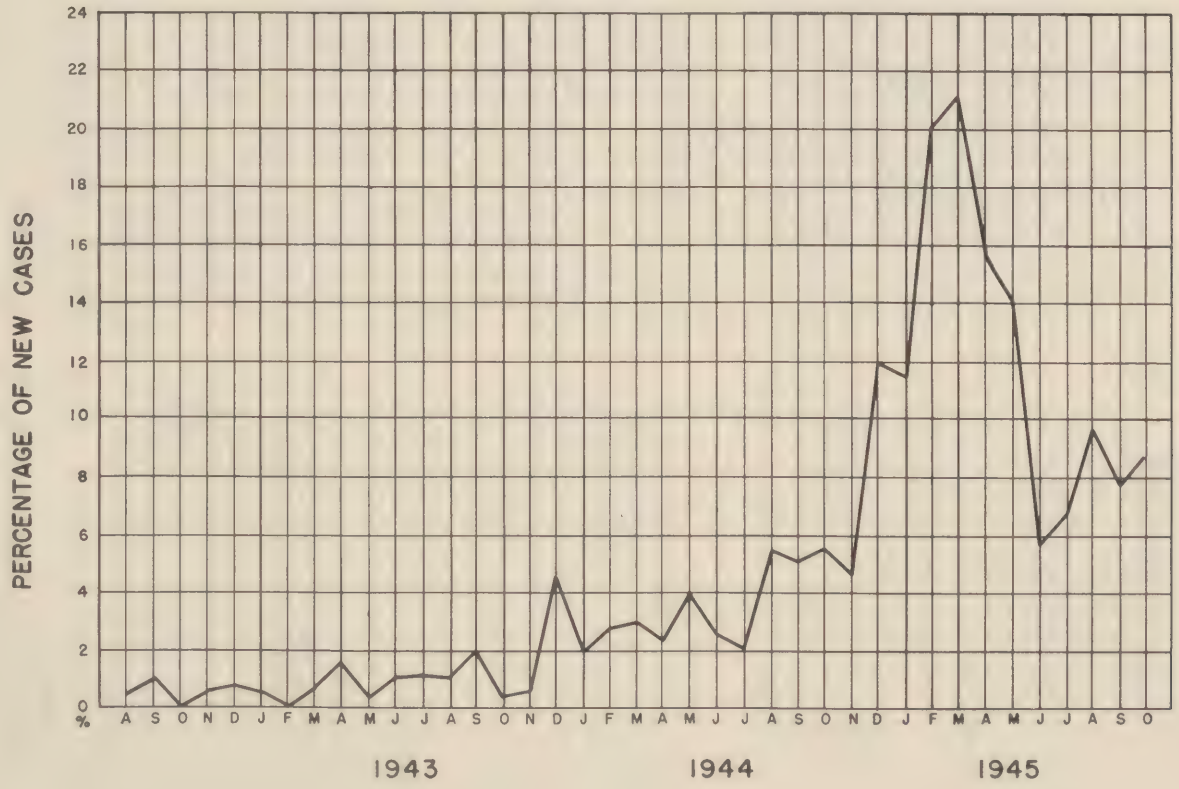


FIGURE 13

TABLE 77.—*Incidence of "war edema' and beriberi with edema among ambulatory out-patients*

[January–September 1945]

Month	Number of patients	"Malnutrition" with edema				Wet beriberi				Other chronic diseases			
		Male	Female	Total	Percent	Male	Female	Total	Percent	Male	Female	Total	Percent
January	1,104	11	0	11	1.00	3	8	11	1.00	1	2	3	0.20
February	614	6	2	8	1.30	2	2	4	.65	0	2	2	.33
March	662	4	2	6	.91	1	2	3	.45	0	1	1	.15
April	695	3	0	3	.43	7	6	13	1.87	2	0	2	.29
May	871	4	0	4	.46	5	6	11	1.26	3	0	3	.34
June	446	0	2	2	.45	2	1	3	.67	0	1	1	.22
July	1,108	1	4	5	.45	2	6	8	.72	1	1	2	.18
August	558	3	0	3	.54	3	5	8	1.43	2	1	3	.54
September	572	7	5	12	2.10	9	6	15	2.62	0	0	0	
Total	6,630	39	15	54	.81	34	42	76	1.15	9	8	17	.26

Source: Keio University Medical School, Tokyo.

TABLE 78.—*Number of cases of "war edema" and beriberi among out-patients by age*

[January–September 1945]

	"War edema"			Beriberi			Other chronic diseases		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Age (years):									
10–20	1	0	1	4	11	15	0	1	1
20–30	2	1	3	6	17	23	2	1	3
30–40	3	1	4	1	4	5	1	1	2
40–50	9	2	11	6	6	12	4	2	6
50–60	13	8	21	10	2	12	0	2	2
60–70	8	2	10	5	2	7	1	0	1
70 and over	3	1	4	2	0	2	1	1	2
Total	39	15	54	34	42	76	9	8	17
Distribution by occupation:									
Laborers	9	0	9	14	3	17	5	1	6
Office Workers	23	2	25	10	13	23	3	1	4
Students	0	0	0	5	8	13	0	0	0
No occupation	6	6	12	5	18	23	1	5	6
Unknown	1	7	8	0	0	0	0	1	1
Total	39	15	54	34	42	76	9	8	17

Source: Keio University Medical School, Tokyo.

TABLE 79.—*Distinguishing characteristics between "war edema" and beriberi with edema*

Subject	"War edema"	Wet beriberi
Blood pressure	Low systolic pressure.	Low diastolic pressure.
Pulse	Low pulse pressure. Characteristically slow.	High pulse pressure. Characteristically rapid.
Heart size	Normal or smaller than normal.	Usually enlarged, characteristically a right-sided enlargement.
Neurological status	Generally normal.	Generally some signs of peripheral neuropathy.
Blood plasma or serum protein levels.	Total protein and albumin fraction frequently below edema threshold.	Generally within normal limits.
Blood thiamine (Vitamin B_1) levels.	Generally normal, may be low.	Generally low, may be within accepted limits of normal.
Response to treatment with thiamine (vitamin B_1).	Unsatisfactory.	Satisfactory.

The major distinguishing characteristics between "war edema" and wet beriberi are given in Table 79. The "war edema" observed in Japan was of two types; edema with low blood plasma proteins (total protein below 5 grams and albumin below 2.5 grams per 100 milliliters of plasma) and edema in the presence of quantities of plasma proteins above the edema threshold. Laboratory observations on cases of both types are presented in Tables 80 and 81. Japanese physicians variously ascribed the latter type to a dietary deficiency in certain essential amino acids (particularly lysine) to calorie deficiency and to a multiplicity of factors. Therapeutic claims were made for gelatin, for the amino acids tryptophane, lysine and cystine (especially lysine), for glycocoll, calcium caseinate, riboflavin, extracts of adrenal cortex and for any easily and quickly assimilated diet providing a source of calories. The exact etiology and the mechanism of the production of "war edema" in the presence of normal blood plasma levels of total protein and albumin are obscure. However, there is no doubt of its association, in man, with seriously inadequate calorie intakes.

Beriberi

The major diagnostic signs of "wet beriberi" are given in Table 79. The outstanding characteristic of "dry beriberi" is peripheral neuropathy. Some laboratory findings are shown in Table 82.

The district physicians' associations reported an increase in the incidence of beriberi during the war in 9 of the 10 districts of Japan proper (Table 74). From what information the Medical Division of the Survey was able to obtain, the increase does not appear to have been great, but seemed to have affected principally infants and children under 12 years of age, pregnant women and urban salaried workers.

TABLE 80.—*"Malnutrition" with edema in hospital bed-patients*

[January–September 1945]

Patient	Age	Sex	Protein (grams per 100 milliliter plasma)				Vitamin B_1 (thiamine) (millicentigrams per per 100 milliliter)			Temperature (° C.)	Pulse rate
			Total	Albumin	Globulin	Ratio A:G	In blood		In urine		
							Total	Free			
Miyasi	63	M	5.806	3.025	2.781	1.08	4.2	3.6	4.8	36.1	52
Ohara	54	F	9.03	3.68	5.35	.69	3.6			36.2	70
Tsuchida		M	6.88	2.59	4.29	.60	6.6	3.6		36.1	58
Mori	59	M	6.34	3.19	3.15	1.01	5.4	1.2		36.1	76
Ogawa	56	M	6.17	3.09	3.08	1.00	6.0	1.8	13.2	35.8	70
Nagao	51	F	7.137	3.631	3.506	.98	4.8			35.8	70
Kishi	60	M	9.22	3.707	5.51	.69	12.1			36.2	58
Tokutomi	75	M	6.38	2.88	3.50	.82	4.2	1.2		35.8	60
Sugita	77	M	6.337	3.187	3.15	1.01	3.6	1.8		36.8	
Yajima	45	F	6.40	2.375	4.025	.54	11.3	7.3		36.0	70
Inaba	56	F	7.687	4.837	2.85	1.69	18.0			36.0	72
Fukuyama	31	F	6.545	3.264	3.281	.98	2.4	0			
Tsurukawa	16	M	8.392	4.13	4.262	.97	6.0			37.0	
Takeda	69	M	7.187	3.187	4.00	.79	12.0			36.2	68
Namiki	44	M	7.485	4.05	3.435	1.18	7.2	4.8		36.0	
Mochizuki	52	F	6.975	3.20	3.775	.85	9.2	4.3			
Inumaru	62	M	5.293	2.918	2.375	1.22	6.8			36.5	78
Nomura	58	F	6.162	2.656	3.506	.76	12.0			36.3	42
Sugitani	67	M	5.812	3.456	2.356	1.47	4.8	2.4		36.0	78
Nakamura	24	F	6.23	2.715	3.515	.77	8.7			36.1	78
Average	53.4		6.87	3.288	3.58	0.955	7.445	2.9	9.0	36.3	66.7

Source: Keio University Medical School Tokyo.

TABLE 81.—*Relation between diagnosis and level of plasma proteins*

	Number of patients	Protein (grams per 100 milliliter plasma)				Ratio A:G
		Total	Albumin	Globulin	Euglobulin	
Normal	10	8.16	5.80	2.36	0.38	2.45
Diarrhea [1]	16	4.64	2.48	2.16		1.15
Tuberculosis (with edema)	10	5.98	3.08	2.90		1.20
Cancer (with edema)	8	6.20	3.28	2.92		1.22
Beriberi	9	6.24	3.76	2.48		1.63
Malaria (with edema)	17	6.59	5.13	1.46		3.49
"War sickness" (with edema, 1944)	16	4.71	1.87	2.84	.68	.67
"War sickness" (with edema, 1945)	6	4.50	1.72	2.78	.79	.64

[1] The diarrhea was considered to be due to malnutrition. Some of the cases had edema and some did not. The cases listed here were studied before 1944. Since 1944 such cases have been diagnosed "war sickness."

The health department of Osaka prefecture reported no increase in beriberi incidence from 1942 to 1944 among 14- to 25-year-old persons (Table 83). The figures given in Table 83 for 1941 are not strictly comparable to those for subsequent years as the age groups are different. The incidence in the country as a whole during the last year of the war has been variously estimated at from 7 to 12 percent of pregnant women ,at 1.5 to 3 percent of factory workers and at 0.4 to 1.0 percent of salaried employees. It was present in about three percent of all admissions to Army and Navy hospitals during 1945, but was never considered a serious problem in the armed forces.

No over-all figures on the incidence of beriberi in Japan proper could be obtained. The death rate from beriberi in 1934 was 17.0 per 100,000 persons (Domestic Economic Research Institute, 1940). The death rates for the six large cities (Tokyo, Osaka, Nagoya, Kyoto, Kobe and Yokohama) for all beriberi and for infantile beriberi from 1937 through 1942 are given in Tables 84 and 85. These suggest a declining incidence of beriberi from 1937 through 1941 and an increase in 1942. However, the figures on death rates for beriberi do not provide a reliable basis upon which to estimate the actual incidence of this disease. The large majority of persons affected with beriberi die of other intercurrent diseases which appear on death certificates as the primary cause of death. In addition, beriberi is frequently chronic in nature and compatible with noninstitutionalized life, on a basis of reduced activity.

Although accurate figures are not available, it is probable that the incidence of beriberi in the general population of Japan in 1945 was not over one or two percent.

Tablets or pills containing thiamine (vitamin B_1) were distributed regularly to many factory workers and to the members of the armed forces. Where this practice was followed it was considered the major factor responsible for the relatively low incidence of beriberi. However, the low incidence in the country as a whole somewhat belies this. Officials of the

TABLE 82.—*Beriberi with edema in hospital bed-patients*

[January–September 1945]

Patient	Age	Sex	Protein (grams per 100 milliliter plasma)				Vitamin B_1 (thiamine) (millicentigrams per 100 milliliter)			Temperature (° C.)	Pulse
			Total	Albumin	Globulin	Ratio A:G	In blood		In urine		
							Total	Free			
Nomora	69	M	5.705	3.062	2.643	1.15	4.2	2.3	16.2	36.1	(1)
Oda	42	F	7.594	4.694	2.90	1.62	5.4	0	----------	36.7	72
Haivzawa	20	F	9.680	3.768	5.912	.65	2.4	0	----------	36.7	(1)
Ogyu	37	F	7.03	3.80	3.23	1.17	2.4	1.2	----------	36.1	----------
Shikamata	18	M	6.872	5.762	1.10	5.12	3.6	----------	8.4	37.0	(1)
Kuzuhara	47	F	6.438	4.876	1.662	2.92	3.0	1.2	11.3	37.3	110
Hagino	22	F	7.00	5.07	1.93	2.62	7.2	1.2	4.8	36.8	70
Murakami	52	F	7.23	5.67	1.56	3.58	12.0	2.4	9.6	37.0	72
Hoshino	20	F	6.749	4.187	2.562	1.64	6.8	2.4	----------	36.9	90
Izuka	18	F	8.068	4.412	3.656	1.20	3.6	1.8	----------	37.1	80
Hayashi	------	F	6.788	4.294	2.494	1.72	4.8	1.8	----------	36.6	90
Average	------	------	7.196	4.509	2.695	2.13	5.04	1.43	----------	----------	----------

[1] Very rapid
Source: Keio University Medical School, Tokyo.

TABLE 83.—*Incidence of beriberi in 14–25-year age groups Osaka prefecture, 1941–1945*

[Case rate per 1,000 examined]

Population group	Case rate			
	1941	1942	1943	1944
Cities, towns and villages	24.2	13.1	11.2	13.3
Students	9.5	6.7	5.0	3.9
Factory workers	43.9	28.7	20.9	15.4
Average	25.9	16.1	12.2	10.9

Source: Osaka Prefectural Health Department.

TABLE 84.—*Number of deaths from all beriberi in the six principal cities, 1937–42*

[Rates per 100,000 population]

Year	Tokyo	Osaka	Nagoya	Kyoto	Kobe	Yokohama	Total
1937	14.1	22.8	20.2	20.5	23.4	17.9	18.1
1938	15.1	19.9	26.8	21.7	27.3	19.2	18.8
1939	9.9	16.8	15.8	13.5	17.6	11.5	13.0
1940	8.1	11.9	9.3	10.4	10.0	6.4	9.3
1941	7.7	10.8	8.1	9.9	10.9	6.5	8.8
1942	8.2	12.0	8.1	10.1	11.2	9.3	9.4

TABLE 85.—*Number of deaths from infantile beriberi in the six principal cities, 1937–42*

[Rates per 100,000 population]

Year	Tokyo	Osaka	Nagoya	Kyoto	Kobe	Yokohama	Total
1937	8.0	9.0	11.5	8.7	10.0	10.3	8.9
1938	7.6	7.6	12.1	9.2	9.7	10.8	8.5
1939	5.7	7.5	8.1	6.3	6.1	6.6	6.4
1940	4.8	5.6	5.5	5.8	5.5	4.4	5.2
1941	5.6	6.1	5.1	5.6	7.1	5.2	5.7
1942	5.9	6.3	5.6	4.9	6.9	6.9	6.0

Ministry of Agriculture and Forestry were inclined to credit a wartime regulation restricting the degree of rice polishing. However, the director of the Japanese Institute for Nutrition informed members of the Medical Division of the Survey that the so-called regulation did not amount to anything more than a recommendation by the government. It would have been impossible to enforce such a regulation, as most of the farmers polished their rice themselves, before marketing. Actually, rice of all degrees of polishing was used by both Japanese civilians and the armed services throughout the war.

The widespread use of vitamin preparations containing thiamine, an increase in the proportion of unpolished and lightly polished rice to highly polished rice in the diet, the adulteration of the rice ration with barley, wheat, other cereals and soybeans, and the progressive reduction in the total calorie value of the diet were all factors tending to protect the Japanese against beriberi.

Diarrhea

During the war, five of the ten district physicians' associations reported an increase in diarrhea not due to infectious causes. As diarrhea was one of the more commonly observed evidences of malnutrition, occurring in from 30 to 50 percent of hospitalized cases, the failure of five district associations to report an increased incidence probably should be regarded as an oversight on their part.

Japanese physicians queried by the Medical Division of the Survey stated categorically that the condition was not sprue and none of them thought it a manifestation of pellagra. The director of the Tokyo Naval Hospital stated that his staff had conducted some studies and were of the opinion that the diarrhea might be due to

niacin (pellagra preventive factor) deficiency. However, their studies had not progressed far enough by the end of the war for them to be sure of this opinion.

Generally, statements by Japanese physicians and health authorities on the occurrence of pellagra in Japan must be disregarded. No Japanese physician interviewed by the Medical Division had ever considered making the diagnosis of pellagra in the absence of the classical skin lesions. Only one, Dr. Fuse of the Osaka Imperial University, admitted to having seen cases of pellagra in Japan. Dr. Fuse stated that pellagra occurred among mountain people who lived mainly on maize and that he had seen it in fishing villages, among people who did not eat fish. Since the beginning of the war, Dr. Fuse had seen one case of pellagra, in a patient from Hiroshima who was also suffering from radiation effects of the atomic bomb. All cases seen by Dr. Fuse had the typical skin changes, with much pigmentation of the legs and feet. When the characteristic mouth and tongue lesions of pellagra (niacin deficiency) were described to Dr. Fuse by a member of the Medical Division of the Survey, he stated that he had observed them frequently in persons with malnutrition but had never made the diagnosis of pellagra in such cases.

Typical pellagrous stomatitis and glossitis were observed by members of the Medical Division in two persons examined in Nagasaki who were under treatment by a Japanese physician for radiation sickness and malnutrition. Similarly, unmistakable pellagra was observed among hospital patients in the city of Kyoto and in the wards of the hospital of Keio University in Tokyo.

Undoubtedly pellagra was not a rare disease in Japan in 1945 and it is probable that much of the nutritional diarrhea occurring in Japan during the war years was due to niacin deficiency, i.e., was pellagrous.

Failures of maternal lactation

Inability of mothers to nurse their infants adequately because of an insufficient quantity or a poor quality of milk, or both, was one of the more widespread and serious manifestations of malnutrition observed in Japan. Six of the district physicians' associations reported it to have increased during the war and to have become a major health problem. It was actually a serious problem only in medium and large-sized cities.

Digestive disorders and under-nutrition of infants

Digestive disorders and under-nutrition of infants were considered major wartime nutritional problems by 6 of the 10 district physicians' associations. It is noteworthy that the infant mortality rate, after decreasing progressively from 1931 to 1941, demonstrated an upward trend in 1942 and 1943, the increase being greatest in 1943 in the six large cities. No data could be obtained for 1944 and 1945.

Scurvy

Scurvy was claimed to be rare in Japan during the war and none was seen by the Medical Division of the Survey. Only one district, Hokkaido, reported an increase and this was confined to the isolated island of Paramushiro. Some scurvy occurred among elements of the Japanese Navy stationed on Hokkaido, but it was an insignificant amount.

Night blindness

Six district physicians' Associations reported an increase in the incidence of night blindness (due to vitamin A deficiency). This is not surprising, but it is at variance with the statements of Japanese nutrition authorities who were interviewed by members of the Medical Division. However, it coincides with the reported increase in suppurative skin lesions and conjunctivitis, both of which may be indications of underlying vitamin A deficiency in the individuals affected.

Skin disease

The incidence of suppurative skin lesions was reported to have increased in the districts of Kinki, Hokkaido and Kanto. Physicians of these districts considered this to be due to malnutrition, although no specific nutritional factor was indicated. Since members of the Survey did not observe any cases of this type, it is possible only to hazard the guess that the malnourished persons with suppurative skin lesions may have had vitamin A deficiency or vitamin C deficiency, or both.

Conjunctivitis

Acute and infectious conjunctivitis increased in the Hokuriku, Hokkaido and Kanto districts. As in the case of skin disease, the district physi-

cians considered the conjunctivitis to be due to malnutrition. Again, it is possible to do no more than assume that the individuals affected may have had vitamin A or riboflavin deficiency or both.

Catarrhal jaundice

Why catarrhal jaundice (acute infectious hepatitis) should be regarded by the Japanese to be a manifestation of malnutrition was not ascertained. It is known to be caused by an infectious agent. Nevertheless, 7 of the 10 district physicians' association reported it as a manifestation of malnutrition that increased in incidence during the war.

A reasonable explanation may exist. Malnutrition predisposes the liver to damage with infectious or toxic agents. Under conditions of widespread malnutrition, acute infectious hepatitis can be expected to increase in incidence, provided both the infectious agent and the opportunity for its dissemination are present. Apparently all of the necessary conditions existed in Japan during the last years of the war.

Summary and Conclusions

Modern Japan has never been self-sufficient in food, and malnutrition has always been of sufficient prevalence to be a serious health problem. However, considerable progress was made during the 10 years prior to 1938 in improving the nutritional status of the people, particularly of those in urban areas.

Although, in the main, progress appears to have continued beyond that date, signs suggestive of deterioration were discernible as early as 1938 to 1940. For example, the incidence of tuberculosis among some groups of salaried, urban workers increased in 1938 as did the incidence of beriberi among salaried employees of the government railroads and the Communications Ministry; tuberculosis was increasing among factory workers as early as 1940. Much of the observed change in the nutritional status and health of wage earners and salaried employees occurring at this time was due to the drafting of able bodied men by the military and to the expansion of industry. However, that this is not the complete answer is indicated by the fact that the average weights of urban school children from industrial districts in 1941 were less than those of urban children of like age in 1934.

A gradual decrease in weight appears to have taken place among urban salaried workers from 1939 to 1943, and male factory workers from 15 to 17 years of age evidenced an average decrease in rate of weight gained in 1942. A second rise in the incidence of tuberculosis also occurred in 1942, as well as an increase in beriberi. However, these changes were slight and adversely affected only a relatively small proportion of the population. No unusual weight loss was observed among industrial workers between the ages of 18 and 60 years (over 90 percent of factory workers) through 1943 that was not ascribable to shifts in the industrial population.

There is no reason to believe that the protein requirements of the Japanese are any different from those of Occidentals, namely 1 gram per kilogram of body weight for adults and between 1 and 1½ grams per kilogram of body weight for infants, children, and pregnant and nursing women. The marked decrease in protein from animal sources and the reduced calorie content of the diet from 1943 to 1945 may have been the cause of the secondary protein deficiency noted in many individuals. The addition of soybeans to the basic ration in 1943 and 1944 was not as effective as might have been expected in replacing animal protein. The reason for this is that the soybean requires prolonged cooking (4 to 5 hours) to make all of its protein biologically available. Most urban Japanese found it impossible to cook their soybeans for this length of time because of the acute fuel shortage and because of the lack of adequate food preparation facilities due to bombing. As a rule soybeans and rice were cooked together for a time long enough to make the rice palatable; i.e., about 20 to 30 minutes. Many Japanese did not like the undercooked soybeans and therefore did not eat their ration of beans. Consequently, the maintenance in soybean supplies noted earlier in this chapter was not accompanied by an equivalent maintenance of actual intake of the nutrients contained in soybeans.

Particularly from 1943 on, when the over-all food supply was definitely limited, the diets of many Japanese were much worse than the per capita figures for the country as a whole would indicate. This was due to the failure of farmers to market their produce and to the rapid growth

of the black market. In 1944 about 50 percent of all food purchased in Japan was purchased in the black market or by "free purchase."

The serious prevalence of malnutrition definitely ascribable to wartime food shortages was first evident among infants, pregnant and nursing mothers and children. The quantity and quality of mothers' milk in the large cities decreased in 1943. In 1942, 71.1 percent of all mothers in Japan successfully nursed their infants without artificial feeding. In 1943, 68.9 percent were able to do this in the country as a whole. In Tokyo in 1944, one study revealed that only 49.1 percent of mothers nursed their infants successfully, compared to 62.1 percent in 1943. The birth weights of infants decreased on the average in 1943 in the large cities and a decrease in the average of pregnant women was observed in 1944.

Infant mortality in the six large cities of Japan increased from a low of 67.6 per 1,000 births in 1940, to 75.4 per 1,000 births in 1943, an indication of deterioration in maternal and infant health. In 1943, 12.53 percent of all children in Japan, from birth to two years of age, were "ill-nourished or poorly developed." Diarrhea and enteritis (including malnutrition), debility and beriberi accounted for 45 percent of the deaths of infants and 31.8 percent of the deaths of children between the ages of 2 and 5 years in Kumamoto prefecture, in 1944.

Comprehensive data on the weights, general health and individual productivity of industrial workers during 1944 and 1945 could not be obtained. Examination of ration data and food supply figures shows that by 1945 the majority of factory workers (95 percent) between the ages of 16 and 60 years were obtaining too few calories to perform the work required of them. The incidence of specific deficiency diseases, such as scurvy, remained insignificant throughout the war among industrial workers.

Urban salaried workers demonstrated greater weight losses and rates of increase in incidence of beriberi, "war edema" and tuberculosis than did factory workers. However, their general health was better than that of factory workers before the war and the incidence of serious malnutrition and of tuberculosis among them never attained the incidence existing among factory workers during the war.

In 1945 the food supply in Japan proper was sufficient to supply an average of only 1,680 calories per capita per day. Even an equitable distribution of this food would not have provided the Japanese with more than about 86 percent of the restricted wartime requirements laid down by the Japanese Committee on Efficiency of Nutrition. It was claimed by Japanese health authorities interviewed by the Medical Division of the Survey that by the end of the war 100 percent of urban dwellers had suffered weight loss. The nutritional status and health of rural people appears to have actually improved during the war.

The incidence of malnutrition, as determined by loss of weight, anemia, apathy, decreased endurance, decreased desire to work and decreased resistance to tuberculosis and other infectious diseases was found to have been widespread in 1944 and 1945. This would be compatible with known facts regarding food supply, but the rate of incidence of malnutrition is a matter for conjecture. Beriberi decreased in prevalence from 1938 to 1942, increased slightly in 1942, and then remained at a rate of incidence which was comparatively low for Japan during the rest of the war. Scurvy was very rare. Pellagra occurred but its incidence is not determinable because of the failure of Japanese physicians to make the diagnosis. Diarrhea occurred in 30 to 60 percent of all patients hospitalized for malnutrition and was a frequent complaint among ambulatory cases.

Gross vitamin A deficiency was uncommon. "War edema" appears to have surpassed beriberi in importance and incidence during the war. From the limited data available, it appears that the incidence of all of these conditions did not total more than 5 percent in the urban population of Japan by the end of the war. The incidence of all malnutrition (any under-nutrition great enough to seriously and adversely affect health and efficiency at work) must be considered to have been at least four to five times as great, i.e., 20 to 25 percent of the urban population. Under-nutrition of a lesser degree might be expected to have a deleterious effect on a worker's productivity through its effect upon his morale. This degree of under-nutrition appears to have been quite general in 1944 and 1945.

Absenteeism in war industries increased among both men and women from 1938 to 1942

and rose sharply again in 1945. The rise in 1943, which continued until the end of the war, was blamed by the Japanese largely on food shortages. Two factors were at work here:

(1) The fear of food shortages which lead to leaving work to hunt for food.

(2) Actual ill health and loss of desire to work arising from malnutrition.

Throughout the war the first of these factors was by far the most important, although actual malnutrition steadily increased in importance during 1944 and 1945.

The nutritional status of the Japanese was deteriorating prior to strategic bombing and continued to do so throughout the bombing period. In the bombed areas nutritional deterioration undoubtedly was increased by the bombing, but the extent of the acceleration could not be determined. Malnutrition was a definite factor in determining the chances of full recovery from nonfatal bomb injuries. Japanese physicians queried by the Medical Division of the Survey were unanimous in stating that many injured people died because of preexisting malnutrition or because it was not possible to obtain the food to feed them properly after the bombing.

Actual famine was not observed in the three southern islands of Japan proper during this survey except among completely homeless migratory persons in bombed areas, e.g., in Tokyo and Osaka, who congregated and camped in public buildings such as railroad stations.

IV. ENVIRONMENTAL SANITATION

GENERAL

In attempting to evaluate the effect of incendiary bombs interspersed with a limited weight of high explosives upon the health of the residents remaining in a bombed city, a great number of factors must be considered. Many of these are intangibles and for others the data are fragmentary. The direct effect of the bombing on health conditions in the target areas as well as in the country as a whole was difficult to evaluate. Sanitary services, housing conditions, food supply and other environmental conditions were adversely affected by war conditions. Had it been possible to survey the effects of the bombing on all cities attacked and to have made more detailed study of specific instances, a more accurate analysis would have been possible. However, even with the limited number of cities surveyed and the short time allotted to each, reasonable assumptions can be made as to the over-all effect of the bombing.

The effect of bombing upon the sanitary environment, and this in turn upon the health of the people, extended beyond the area of the target cities. Directly and indirectly it extended to the whole country, particularly Honshu and Kyushu and, to a lesser extent, Shikoku. The bombing directly affected the sanitary environment of the population remaining in the city, but these changes had little effect upon those who were compelled to evacuate and find shelter and food in other areas. The evacuated population, however, was subjected to sudden and greater changes in environment than were those remaining, and their impact on other and smaller population groups throughout the country modified the conditions in these areas. The extent of the impact of increased populations upon the smaller cities and villages throughout Honshu, Kyushu and Shikoku can be appreciated when it is realized that during the period of March to August 1945 inclusive, the number of persons, including schoolchildren, evacuated from the target areas equalled approximately 27 percent of the population of the three islands exclusive of the population of the target cities. Such a mass movement of population, not uniformly distributed, must have created sanitary problems in the reception areas that would have adverse effects on health in general.

The measure of the health effect in any of the environmental changes brought about in the country as a whole by the bombing should be indicated in its vital statistics. However, effects not immediate in character tend to show in vital records only over a period of time and therefore may not be truly reflected in the records now available.

That portion of Japan within which the target areas were located is not extensive enough to provide varying topographic, geologic or climatic conditions or varying characteristics of the people or of their customs and habits. The different factors concerned in environmental sanitation, therefore, do not vary greatly in the individual areas. Also, the bombing followed much the same pattern in each area. Since these factors were more or less common, the observations made in a few cities probably represent fairly accurately the over-all effect in the various target areas.

WATER SUPPLY

General

The water resources of Japan, when properly conserved and developed, provide ample water for the needs of the population. Because of the climate and geologic conditions, run-off to the streams is fairly uniform and ground water is found at relatively shallow depths. Catchment areas are generally small, so that the development of more than one source of water supply for the larger cities is required.

From the standpoint of physical and chemical characteristics the water from both surface and ground sources is satisfactory for public supplies. Except during periods of exceptionally heavy rainfall on the catchment area, the stream water is fairly free of turbidity. Both surface and ground water can be classed as soft water. The hydrogen ion concentration (pH) range of surface waters is satisfactory from the water treatment standpoint. An exception is the water of the Edo River at Tokyo, where at times, due to volcanic action in the drainage area, the water is slightly acid.

The bacterial content of the water of infiltration wells and galleries and other wells used for public supplies is generally low, and that of the

rivers is much lower than would be expected where the population is concentrated in the narrow valleys and where all arable land is fertilized with night soil. The lack of sewerage systems in the small cities and villages located along streams above waterworks intakes, and the necessity of conserving both land and water in the national economy tend to reduce the direct pollution of the streams.

Public Water Supply

In general the water supplies of the cities are taken from streams, impounding reservoirs, or infiltration galleries or wells in the stream beds. Approximately 84 percent of the cities obtain the major part of their supply from these sources. The development of both surface and subsurface water supplies from the same stream permitted the maximum utilization of the run-off from the catchment area. An example of this is at Tokyo, where water is taken directly from the Tama River at three points and from infiltration galleries in the river bed at two other points. Both shallow and deep wells are used to supplement the supply in some of the larger cities. Wells and springs are the main sources of supply in the smaller communities that have public water supply systems.

Water from rivers, impounding reservoirs and infiltration galleries is generally treated before delivery to the distribution systems. Slow sand filtration, with or without presedimentation, in uncovered filter beds is the more common treatment, although the rapid sand type of treatment is being installed at newer developments. At the larger installation at least, post-chlorination of the water was practiced prior to the war. The shortage of chlorine and chlorine compounds brought about by the diversion of output to military uses, the reduced production due to lack of salt and, perhaps in 1945, to destruction of chemical plants, limited the use of this very important chemical in all waterworks. Lack of high-grade aluminum sulphate (filter alum) and the use of an inferior quality or none at all reduced the efficiency of those plants where coagulation and settling of the water prior to filtration were required.

The larger waterworks installations included laboratories, and the treatment processes were operated under laboratory control. Following the outbreak of the war, replacement of equipment and apparatus and procurement of material necessary for properly preparing bacterial media became increasingly difficult. This together with other factors tended to reduce the quality and quantity of laboratory work. The absence of complete and reliable records makes it difficult to determine the probable safety of the water for human consumption prior to and during the attack period. In general, however, the quality of the water delivered from the treatment plants during the period following the bombings was probably about the same as that during 1944.

According to the records available, the number of public water systems in Japan totaled 645, serving approximately 40 percent of the population. Of this number 142 were systems for cities with population in excess of 30,000. Information on 97 of the 142 cities showed that 21 obtained their water supplies from wells or springs, and 76 from rivers, lakes, impounding reservoirs, or infiltration galleries and wells in the river bed. Less complete information is available on the extent and type of water treatment in the several cities. It is probable that the supplies from surface and infiltration gallery sources were filtered prior to use. This is known to have been the case in 57 cities, slow sand filtration being the method used in 49, rapid sand filtration in two and both methods in six. Both types of treatment were also employed in some of the cities which obtained their supplies from wells and springs. For the most part, slow sand filters were not covered (Figures 14 and 15).

Potable water standards, both chemical and bacteriological, had been promulgated by the national government and by the Japanese Water Works Association. Standard methods of examination of water had also been established by both agencies. These methods did not differ greatly from those set forth in the earlier editions of the Standard Methods of Water Examination, American Public Health Association.

The bacterial standard for drinking water established by the Japanese Water Works Association was as follows:

> (1) Cultured in nutrient agar base for 48 hours at 20°–22° C., bacterial count must be less than 100 per milliliter of water; or at 37° C., for 24 hours the count must be less than 50 per milliliter.

FIGURE 14.—Slow sand filter dewatered, showing type of construction.

FIGURE 15. Slow sand filter in operation.

(2) Examination of 1 milliliter in Endo culture medium produces a negative reaction.

(3) Coliform organisms negative in 10 milliliters of water. The national standards do not provide for the bacterial count on nutrient agar incubated at 37° C., for 24 hours.

Some cities had adopted the national standards while others followed the Water Works Association standards. It is understood that either was considered official.

The general appearance of the laboratories visited was disappointing. They were dingy, cluttered with equipment and far from what would be expected of a well-operated laboratory. Usually laboratory report forms were adequate, but the lack of complete records covering the period prior to and following the bombings raised some question as to whether or not routine examinations were carried on during those periods.

It appeared to be customary in the larger cities at least, to install the water distribution system in two or more independent parts and to operate each as a distinct entity. In general, however, these systems were interconnected through valved connections. Where more than one source of water was developed each served a separate tributary system. The installation of independant systems serving different sections of a city may have been for the purpose of earthquake protection, but this type of installation should have been equally efficacious in case of bombing by high explosives. The normal daily per capita consumption of water in the larger cities ranged from 40 to 60 gallons. This relatively low amount was due in part to the lack of flush toilets as indicated by the official reports for 1938 which gave the total number of flush toilets in Japan as 103,161 (of which 63,518, or 62 percent, were in Tokyo) and to the use of water from shallow wells to supplement the public supply, probably as an economy measure.

Public Water Supplies of Five Leading Cities

Tokyo—The water demand of Tokyo, exclusive of the areas annexed in 1943, has increased to such an extent that numerous sources have been developed and treatment plants constructed from time to time. Since the system of each development or treatment plant constituted a separate entity independent of other systems, except for the valved interconnections, the water system as a whole presented a somewhat complicated picture. In all there were 17 systems each with its own name.

Sixty-eight percent of the water supply was from the Tama River and infiltration galleries in the river bed; 29 percent was obtained from the Edo River; and 3 percent of the supply was drawn from numerous well developments (Table 86).

TABLE 86.—*Source, type of treatment and capacity of various water systems*

System	Source of water	Type of plant treatment			Capacity of plant (gallons per day)
		Slow sand units	Rapid sand units	Chlorination	
Sakai		20		Yes	63,471,144
Yodob-shi	Tama River	24		Yes	63,471,144
Komae	Tama River and wells	4		Yes	3,291,680
Kinute-Kami	Tama River infiltration	6		Yes	22,038,456
Tama awa		10	14	Yes	27,548,400
Chofu	Tama River	2		Yes	
Kanamachi	Edo River	12	34	Yes	83,477,496
Yoyohata or Sekiyama.	Artesian wells		3	Yes	2,845,920
Suginami	Shallow wells	3		Yes	2,465,496
Yaguchi	Deep wells	3		Yes	734,712
Eight individual wells systems.	Deep wells	8		Yes	2,112,000
Total					271,456,448

While the design capacity of these plants as a whole was given as 284 million gallons per day, the daily output in 1944 was 315 million gallons or 11 percent above the designed capacity. This is not significant from the standpoint of operation since the character of the water and type of treatment would permit such an overload. It is significant, however, from the standpoint of supply since it indicates the need for an additional quantity of water or for additional plant capacity. Extensions to the system, with additional plant capacity of 127 million gallons per day, had already been planned.

Control over plant operation was through laboratories at the larger installations. The Hygienic Laboratory of the Ministry of Health and Social Affairs also examined the plant effluents at 1- to 2-week intervals and occasionally examined samples of water from the distribution systems.

During the war a shortage of chemicals interfered with efficient operation of the treatment plants to such an extent that more than half the time the plants were operated without chemi-

FIGURE 16. Portable emergency filter for supplying drinking water.

FIGURE 17. Portable emergency filter showing filter plates.

cals. This undoubtedly caused deterioration in the quality of the water, particularly the supply from these plants having the rapid sand treatment process.

The distribution systems extended to practically all parts of the city and supplied water to 900,000 households or 90 percent of those within the area served. The average daily consumption prior to the air raids varied between 50 to 60 gallons per capita.

The Water Department took definite steps to supply drinking water in case the public supply failed because of bomb damage. Property owners were urged to sink additional shallow wells, with the city paying 75 percent of the cost.

The number of wells sunk and equipped with pumps totaled 3,802. Small vials of chloride of lime were distributed to the householders for disinfecting the water from shallow wells if its use became necessary. They were also provided 210 wooden tanks with a capacity of 660 gallons each, along with 20 trucks for their transportation. No provision for disinfection of the water to be transported was made. Eight mobile filter units were built and their efficiency checked for the various surface and well waters throughout the city. Each of these units had a capacity of 10,560 gallons per hour. Chlorination of the effluent was not provided (Figures 16 and 17).

Due to the character of the bombing, however, these emergency measures were not used. One hundred and forty-eight of the wooden tanks were destroyed in the air raids.

Yokohama—The Yokohama public water supply was derived from two sources to the west of the city—the Doshi River, and infiltration galleries in the bed of the Sagami River.

The water from the Doshi River was coagulated and settled in a plant near the source and then flowed by gravity to the filtration plant near the city. The yield from this supply was stated to be 45.6 million gallons per day. The water from the infiltration galleries was pumped to an equalizing and pressure reducing reservoir at Kawai where it was mixed with the water from the Doshi River. The yield of the infiltration galleries was given as 38.8 million gallons per day.

The water supply of Atsugi was taken from the equalizing reservoir at Kawai and treated in a small, slow sand filter plant of 0.5 million gallons per day capacity.

The treatment plant for the city supply consisted of two units, one a slow sand filter installation of eight filters with a combined capacity of 34 million gallons per day, and the other a rapid sand installation with 12 filter units which had the same combined capacity as the slow sand plant. The equipment for post-chlorination had a total capacity of 265 pounds of chlorine per day. A laboratory constituted a part of the treatment plant. As in the case of other water-works, the shortage of chlorine and coagulating chemicals interfered with efficient operation of the treatment plant. Based on the average consumption of water in 1944 the treatment plant was operated close to its designed capacity.

The distribution system was not accessible to the entire population of the city, but supplied 156,398 households or 73 percent of the population.

In order to provide an emergency supply of water for drinking and firefighting purposes, 200 covered concrete tanks with capacities ranging from 10,600 to 26,000 gallons each were constructed in the more densely populated sections of the city. These tanks were filled with city water. Due to the type of air raids no use of these emergency supplies was possible, and the existing local wells were depended upon for emergency supplies.

Osaka—The Osaka water supply was obtained from the Yodo River near the upper limits of the city. It is estimated that the population of the drainage area, including the city of Kyoto, was approximately 1.7 million. About 10 percent of the drainage area was under cultivation.

No raw sewage was discharged directly into the river, but treated sewage was discharged into one of its branches at Kyoto.

The river water had an average turbidity of 10 parts per million, and a hardness which varied between 20 and 40 parts per million. The bacterial content of the water varied from 200 to 300 per milliliter in the winter to 7,000 to 8,000 in the summer (plate count, 46 hours at 22° C.).

The water was treated in three independent filter plants, two rapid sand and one slow sand, all located in the same area and administered as a unit. The water flowed from the river intakes to presettling basins from which it was

pumped to the filtration units. All water was coagulated and settled prior to filtration. The slow sand filtration plant consisted of three chemical houses, 10 settling basins having a capacity of 61 million gallons, and 24 open filter beds with a combined capacity of 101 million gallons per day. Each rapid sand filtration plant was a complete unit in itself; Plant No. 1 had a capacity of 30 million gallons per day and Plant No. 2 had a capacity of 92 million gallons. Post-chlorination was provided through five stations having a combined capacity of 966 pounds of liquid chlorine per day. One station was equipped with an ammoniator having a capacity of 18 pounds of ammonia per day.

The treated water was discharged into 10 covered, clear water basins which had a combined capacity of 41 million gallons from which it was pumped to the distribution system.

A chemical and bacteriological laboratory was located at the treatment plant. During the war this plant suffered a shortage of chemicals and the coagulating chemicals available were of poor quality. However, there was no information indicating that the plant had been entirely without chemicals during the war. The coagulating chemical dosage ranged from 10 to 50 parts per million depending upon the character of the river water. The filtered water received a chlorine dosage of 0.3 parts per million which provided a residual of 0.05 to 0.1 parts after eight hours contact. The average 37° C., bacterial count of the water as delivered to the distribution system was stated to be 10 per milliliter.

The distribution system was in three distinct parts with valved-off interconnections. Each had a high-duty pumping plant. Except for six pumps in one station, all the pumps were electrically powered. The systems operate on a direct pump pressure of 78 pounds per square inch. All parts of the city were accessible to the systems which supplied 650,000 households with a population of approximately three million prior to the air attacks.

The capacity of the waterworks was 227 million gallons per day and the consumption prior to the air raids was 161 millions gallons per day or about 50 gallons per capita.

Kobe—This city's water came from three impounding reservoirs located north and northeast of the city and from the Hashin Associated Water Works which obtains its water from the Yodo River just below the intake of the Osaka supply.

The water from each of the three reservoirs was treated by either slow sand or rapid sand filtration. The Yodo River water was treated in a slow sand filtration plant located in Amagasaki. The effluent of all plants was normally chlorinated.. The treatment plants are supposedly under laboratory control.

The city-owned distribution system was in three parts, and each was supplied by its respective reservoir and treatment plant. The Hashin system was stated to supply about 20 percent of the population in the area adjacent to Nishimamiya.

The daily consumption prior to the bombing was 58 million gallons or about 58 gallons per capita. The information available indicated that the supply was inadequate for the needs of the city.

Nagoya—The main source of the Nagoya water supply was Kiso River, northwest of the city. This source is supplemented by deep wells. The water was treated in a slow sand filtration plant with a capacity of 80 million gallons per day. Post-chlorination normally was practiced.

Bomb Damage

Eighty of the 94 cities subjected to various degrees of bombing had public water supplies. Information on the public water supply status of the 141 towns bombed was not available.

Bomb damage to water treatment plants of the five large cities was not sufficient to interfere with their continued operation. The main pumping installations likewise escaped major damage, although in some instances power failure interfered with continuous operation. Booster stations in the target areas generally were put out of service.

The principal damage was to the distribution systems. The destruction of mains and laterals was roughly proportional to the quantity of high-explosive bombs dropped. According to waterworks officials, breaks in mains and laterals were repaired within a reasonably short time. In repairing these broken mains an attempt was made to disinfect them with chlorine or chlorine compounds before restoring them to service. The usual procedure was to flush until the water came clear. Incendiary bombing had

FIGURE 18. Flush fire hydrant used to supply domestic water.

FIGURE 19. Leaking service pipe.

little effect on underground structures, but the destruction of buildings by both types of bombs caused the breaking or at least the leaking, of building service pipes. The closing of these service pipes presented a problem due to their number, the difficulty in finding cut-off cocks, and the lack of manpower. Delay in eliminating loss of water through these leaky service pipes, as well as other water losses from undetected leaks in mains, necessitated the pumping and treatment of a supply of water about equal to that required prior to the bombing, despite the sharp reduction in the number of people served.

This continued leakage and the destruction of booster pump stations brought about reduced and varying water pressures in the systems. This situation not only affected the continuity of supply in many sections but also introduced a serious health hazard by creating the possibility of backflow, and contamination of the water in the systems. At the time of the survey the work of eliminating water losses had been only partly accomplished and several months would have been required to complete the work. Until this work has been completed and proper maintenance of the systems restored, the health hazard will continue and may be accentuated as evacuees return and erect temporary abodes in the devastated areas (Figure 18). Procurement of increasing supplies of chlorine to enable heavy chlorination of the water entering the systems may reduce the hazard to some extent.

The disruption of the distribution systems with the possibility of contaminated water nullifies the use of filter plant laboratory records in judging the quality of the water delivered to the consumer. The lack of information on the quality of the water delivered during the critical period made it impossible to judge the extent to which bombing caused conditions that affected the quality.

Increases in dysentery and typhoid fever at Kobe and Nagoya and an increase in typhoid fever at Yokohama in the months following the air raids were of such nature as to implicate the public water supply in part, if not wholly. Up to the time of the survey Tokyo and Osaka showed no abnormal increase in the prevalence of these diseases over that of the previous 4 years.

Effect of Bombing on Certain Public Water Supplies

Tokyo—High-explosive bombing damaged intakes and conduits to treatment plants at eight places and put out of service five slow sand filter units at one treatment plant. Incendiary bombing damaged one well development sufficiently to throw it out of service and caused severe damage at another. While these damages somewhat reduced the over-all capacity of the supply, they did not interfere with the delivery of water to the city.

During the various raids, high-explosive bombs caused 381 breaks in the mains of the distribution system. The majority were in smaller mains, although a few of the larger mains were broken. The largest main broken was 32 inches in diameter.

As a result of the raids and particularly those of 9 March and 29 May 1945, 555,800 house service pipes, between 60 and 70 percent of the total in the city, were left in a leaky condition. The loss of water from these leaking services was sufficient to reduce the water pressure in the system in many sections and to suspend service entirely in some. Despite the efforts of the water department only about one-third of these service pipes had been shut off at the time of the survey (Figure 19).

During the latter part of October 1945 the consumption of water, or rather the demands upon the procuring and treatment works, was 306 million gallons per day. This was only slightly less than the requirements prior to the bombing, notwithstanding a 60- to 70-percent reduction in the actual number of consumers.

According to statements made by waterworks officials, laboratory control over treatment plant operations was maintained throughout the bombing period, and there was not deterioration in the quality of the water delivered by the plants during that period.

Laboratory results from the several treatment plants for June and July 1945 indicated that the average number of bacteria in the treated water was well within the standard of 50 per milliliter. Coliform organisms were reported as absent in 10 milliliter amounts of treated water at all plants in June, and at all except the Tomagawa and Komae plants in July when the average was two and three, respectively. With one exception the plant effluents showed no residual chlorine during June.

Little information was available as to the

quality of the water delivered to the consumer during the period while the city was under attack and immediately following. A few samples were collected from the distribution system and examined in the Toyko Hygienic Laboratory. The results of these examinations are shown in Table 87.

The number of samples examined was not sufficient to permit one to judge the quality of the water delivered to the consumer. However, the results of the examination in April, May and October 1945 would indicate that the quality of the water varied considerably and at times was below standard. Information from waterworks officials indicated that coliform organisms were present in the filtered water during the war when chemicals for coagulation and disinfection were not available.

Yokohama—The bombing caused some interference with power sources but did not greatly interfere with the continuity of the water supply at Yokohama.

Distribution mains were broken in 86 places but supposedly were promptly repaired. Fifty-nine of the breaks were in 4-inch pipes and the remainder were in mains 6 to 28 inches in diameter. Two high-pressure pumps in the system were also damaged.

Of the building service lines, 108,693, or 70 percent of the total, were broken and to a large extent still remained broken at the time of the survey, causing great loss of water and varying water pressures in the mains. These conditions offered opportunities for contamination of the supply through backflow.

Interruption in power and the necessary repairs to pumping equipment at booster stations have interrupted service to the higher areas of the city for varying periods of time since the air attacks. This interruption of service accentuated the possibility of backflow due to alternately filling and emptying of mains. The amount of water delivered to the distribution system increased after the bombing and reached 70 million gallons per day in October 1945. This exceeded the rated capacity of the treatment plant.

Typhoid fever records indicated a considerable increase in the prevalence of that disease which abruptly reached a peak in September 1945 and subsequently followed by a sharp decline. Water might well have been a factor in the increase.

Limited laboratory records for July and August 1945 indicate that the total bacteria per milliliter was well within the standard, but there were no records available of the examination for presence of coliform organisms. On the days the samples were taken the plant effluent contained no residual chlorine. Six samples collected from the distribution system in the area of interest to the Occupational Forces and examined in November 1945 indicated that the water at that time was potable and the residual chlorine ranged from 0.1 to 0.35 parts per million. These results are not indicative of the quality of the water in other sections of the system nor of conditions occurring after the attack.

It is questionable if the quality of the water nearer the periphery of the system was satisfactory because of the possibility of backflow due to fluctuating pressure in this area.

Osaka—The raid of 14 March 1945, burned a water department power plant but apparently did not effect the continuity of the supply to the city. Likewise the raid of 6 June 1945 damaged two of the settling basins of the slow sand filter plant without affecting plant operation. Power failure following this raid caused a complete

TABLE 87.—*Results of examination of water samples collected from the water distribution system*

	1944		1945									
	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.
Number of samples examined	2	2	2	2	0	23	18	0	0	0	2	21
Number of bacteria per milliliter developing on agar medium incubated 48 hours at 22° C:												
Maximum	5	5	16	7	-------	42	237	-------	-------	-------	6	199
Minimum	5	4	4	5	-------	1	2	-------	-------	-------	5	1
Mean	5	4.5	10	6	-------	9	21	-------	-------	-------	6	62
Coliform organisms per 10 milliliters of water:												
Positive results	0	0	0	0	-------	2	1	-------	-------	-------	0	3
Negative results	2	2	2	2	-------	21	17	-------	-------	-------	2	18
Percent of samples positive	0	0	0	0	-------	9.5	9.5	-------	-------	-------	0	16.6

Source: Tokyo Hygienic Laboratory.

cessation of water service to the city for a period of 6 days.

The several bombings caused damage to 19 of the larger and 300 of the smaller mains in the distribution system. Repairs to these were stated to have been completed in November 1945.

Damage to building service pipes was excessive and little had been done toward their repair or discontinuance at the time of the survey. It was reported that 30,000 of these were damaged or leaking. This number was much less than in the other cities and was believed to be grossly underestimated. As in other cities these damaged service pipes presented an opportunity for contamination of the supply through backflow.

According to the waterworks officials the amount of water pumped to the system at the time of the survey was only 10 percent less than that prior to the air raids, notwithstanding a 60 percent reduction in service. This would not indicate that leakage was excessive.

It was claimed that there was no deterioration in the quality of the water delivered to the system after the attacks. No records regarding the character of the water delivered to the consumer were available.

Beginning in October 1945, samples of water from 11 points in the distribution system were examined daily and reports were made to the Occupation Forces. The results of these examinations indicated that, with a few exceptions at one station, the water met the bacterial quality standards. Residual chlorine of 0.01 to 0.03 parts per million was present in all samples.

Records of the occurrence of typhoid fever and dysentery following the bombing did not appear to implicate water as a factor.

Kobe—There was great damage to the distribution system, particularly to the building service pipes. Five booster stations were destroyed, with cessation of water service to the sections supplied by them. That portion of the city supplied by the Hashin system was without water because of the destruction of the main feed line.

The amount of water delivered to the distribution system after the air raids was only about 13 percent less than before, indicating that leakage was extensive. At the time of the survey it was reported that about half of the city was on rationed water, which was turned into the mains for a limited period twice a day. This method of rationing, with the existence of leaks in mains and service pipes, presented ideal conditions for contamination of the water within the system. Under the existing conditions the typhoid fever outbreak following the bombings could be attributed, in part at least, to water.

Nagoya—Less information was available for Nagoya than for any other of the large cities. It was known that there were 60 breaks in the larger mains and 800 in the smaller mains of the distribution system, and that five times between December 1944 and April 1945 the water supply was completely off for 3 to 17 days. Since nearly 120,000 buildings were destroyed, damaged and leaky service pipes existed in large numbers. Under these conditions water may well have been the agent responsible for the epidemic of dysentery and typhoid that occurred after the air attacks.

Private Water Supplies

Ground water at shallow depths appeared to have been abundant throughout Japan and was the source of water supply for the inhabitants of communities without public supply as well as for the rural areas.

Shallow wells abounded in all the cities with public water supplies, and the water from these wells was used to a considerable extent to supplement the public supply and as an emergency supply.

These wells naturally vary in depth, depending upon location, but in general fall within a depth range of 15 to 30 feet.

Driven wells with pumps predominated among the wells in the larger cities, particularly where water is obtainable at shallow depths. Dug wells were substantially constructed, with masonry lining which extended above the ground to a height of about 40 inches. These wells were equipped with pumps or had open tops and dippers (Figure 20). Both types appeared to be reasonably well protected from surface drainage, but their location in thickly built-up areas and in close proximity to privies and drains makes the bacterial quality of the water questionable.

The physical and chemical characteristics of well water in the flat areas of the cities near the sea was much less satisfactory for domestic

FIGURE 20. Typical dug well.

purposes than was the water from the public supply. The hardness was greater, as may have been the content of other chemical constituents, particularly iron; a factor of considerable importance where tea is a universal beverage.

Economy seemed to have been the only reason for the continued use of well water where a public supply was available. Information from 63 cities which had public water supplies indicated an average of one well for each six households.

In addition to the shallow wells, deeper wells had been sunk for use of the larger buildings in the cities. Water from these wells was used as a standby in case of failure or lowered water pressure in the public supply. It was understood that in some of the taller buildings these wells supplied water to the upper stories not reached by the public supply under normal main pressures.

Little could be learned as to the chemical or bacterial characteristics of water from these deep wells. Information on the number of wells in five large cities prior to the air raids is shown in Table 88.

TABLE 88.—*Number of private wells and population per well in 5 large cities*

Place	Number wells reported	Average population per well
Tokyo	250,000	26
Osaka	50,000	58
Yokohama	15,865	69
Kyoto	120,000	39
Kobe	23,545	43

Source: 16th Annual Report, Tokyo Hygienic Laboratory, 1939.

In 1939 investigations covering location, type and construction of wells, together with laboratory examination of the water were undertaken in Tokyo, Osaka, and Kobe. A similar investigation was carried on in Yokohama at about the same time. The results of the investigation in Tokyo were published in the 16th Annual Report, Tokyo Hygienic Laboratory, Ministry of Health and Social Affairs, 1939. This report also included some information on the investigations in Kobe and Osaka.

Health officials in Tokyo stated that the investigation was undertaken because of the possibility of a water shortage due to the drought conditions existing in 1939. This may have been the reason in part, but the real reason given in the report was "From the standpoint of air defense, epidemic control, maintenance of health and fire protection, an investigation of all public and private well water within the city was indispensable." The number of wells located and reported in Tokyo was 179,986, and in Kobe, 23,545. No figure was given for Osaka.

The laboratory examinations of the water in the Tokyo investigation were confined to the physical and chemical characteristics, without bacteriological examination. Location, construction and sanitary protection were also considered in determining the safety of the water.

The Osaka standards were similar to those used at Tokyo except that the number of bacteria per milliliter of water was set at 100 and the number of red colonies developing in Endo medium at 0 per milliliter. These standards were probably used at Kobe also.

The results of the examination are shown in Table 89.

TABLE 89.—*Comparative percentages of results of well water quality—Tokyo, Osaka and Kobe*

	Suitable	Unharmful	Suitable After—			Unsuitable	Miscellaneous
			Filtering	Boiling	Boiling and filtering		
Tokyo [1]	20.5	53.8	10.9	6.9	6.5	0.9	0.9
Osaka	.1	1.0	16.1		11.0	71.8	
Kobe	2.4	12.8		15.4		69.4	

[1] Bacteriological examination not made.

The standards used at Yokohama differed slightly from those in the other three cities. These standards permitted a bacterial content of 300 per milliliter of water. Results of examinations of the water of 15,865 wells showed 10,940 potable, a number which leads one to believe that the bacterial examination was not considered.

Examination of the water from some 6,000 wells in Kyoto in 1943 showed that 30 percent had a bacterial content of less than 100 per milliliter and were approved for use without treatment. It may be assumed that the water from wells in the Kyoto area would be of somewhat better quality than that from wells located in the low coastal areas of the other cities.

The universal habit of drinking tea, which requires boiled water, the minimum use of cold water as a beverage, and the cooking of most foods, probably safeguard the users of well

water to some extent from diseases that may be transmitted by water. Nowithstanding these habits, the use of water for drinking and culinary purposes from shallow wells located in thickly populated areas cannot be considered good hygienic practice. The bomb damage to water distribution systems, which had caused lowered and varying water pressures, had forced a considerable percentage of the urban population remaining in the cities to resort to wells for their water. The extent to which this may have influenced health conditions was not possible to evaluate. However, it should be considered as one of the health hazards created by the bombing.

SEWAGE COLLECTION AND DISPOSAL

Before attempting to evaluate the effects of bomb damage to sewerage systems upon the public health one must realize that the disposal of human excreta in Japan differs from the practice in the United States. The Japanese value this material highly as a fertilizer and for many years they have maintained systems for its collection and disposal in all cities, towns and villages. Where sewerage systems have been installed they are primarily for the purpose of draining the land of foul water such as street run-off, laundry wastes and wash water. Fecal material is deposited in separate pits or night soil receptacles from which it is removed periodically and transported to farm areas.

This widespread custom of salvaging human excreta has had an important bearing upon sewage disposal as an item in environmental sanitation. First, it has necessitated the maintenance of a considerable amount of equipment and manpower for its disposal and, second, it has lessened the need of installing the western type of sewerage system which conveys both liquid and fecal solids.

Night Soil Collection and Disposal

The common type of toilet (Benjo) in Japan consisted of a low porcelain or enamel "squat" bowl mounted over a receptacle for the wastes (Figures 21 and 22). The receptacle was usually a vitrified clay jar or tub 18 to 24 inches in diameter and 20 to 30 inches deep, or, as was often the case, a pit lined with wood, masonry, or concrete. In the lower class homes, the bowl was omitted, leaving only a slot cut into the platform over the receptacle (Figure 23). In more pretentious homes, a urinal was often installed in a separate compartment of the toilet room. Very few flush toilets had been installed and practically all of these were in the modern buildings of the larger cities. Most flush toilets were directly connected with the city sewer, but in quite a few cases, these toilets discharged into a night soil receptacle that had an overflow connected to the sewer.

Throughout Japan in 1938 there were only about 84,000 flush toilets connected with city sewers, and more than 90 percent of these were in Tokyo and Nagoya. In addition, at that time, there were about 19,000 flush toilets connected to individual sewage disposal systems consisting of septic tanks with or without soil absorption fields, however most of these were also in those two cities. Apparently this type toilet was becoming increasingly popular in the years preceeding the war as reports from Tokyo indicate that there were 76,730 flush toilets in that city alone by the end of 1941. After the bombing attacks this number had decreased to 39,110 because of the destruction of buildings in which they were installed.

The human excreta or night soil was removed from the receptacle at various intervals depending on local conditions, usually every 2 weeks. In the outlying areas of the city farmers collected the material and transported it to their land in wooden pails commonly called "honey buckets" by the Americans. Horse or ox-drawn wagons were the usual means of conveyance, although sometimes the carts were manually pulled and in some cases the pails were strapped onto oxen or horses (Figure 24). The pails were covered and generally appeared to have been kept quite clean. However, there was usually no question as to their contents due to the offensive odor.

In the more densely populated areas of the cities where the length of haul made it impractical for the farmers to collect the material, the collectors were made by the city or by licensed "merchants" under city supervision. Here also wooden pails were used and the material was transported by horse carts or trucks either to farmlands outside the city or to the dock areas where it was loaded onto barges for shipment

FIGURE 22. Vitrified china, squat type, toilet bowl with foot-operated flushing device, installed in modern office building, Tokyo.

FIGURE 23. Outdoor toilet consisting of slotted platform over earth pit housed in temporary wooden building. Tokyo bombed area.

FIGURE 21. Japanese toilet (Benjo) consisting of urinal and "squat" bowl mounted over a pit, housed in temporary building. Tokyo bombed area.

to rural areas or disposal at sea (Figure 25). In most cases the householder was required to pay for the removal of the material. At Tokyo, the charge was 50 sen (about 3 cents, post-war exchange rate) for each pail of 20 liters removed.

Some conception of the amount of night soil collected and the equipment required may be obtained from the situation at Tokyo. Before the war, more than one and one-quarter million gallons of night soil were removed daily from a total of 1,025,025 houses within the city. During the war the collection schedules were reduced somewhat due to the increased demand for the material by home gardeners and the lack of fuel and manpower for operation of motor and other vehicles. Consequently, just before the city was bombed, collections were being made from a total of 892,650 houses and the amount removed was slightly less than one and one-quarter million gallons per day (about ¼ gallon per person per day). This latter schedule required a fleet of 83 motor vehicles and 872 trailers manned by 83 drivers, 83 assistants, and 864 collectors. In addition, a total of 109 boats, tugs and barges with crews totaling 130 men was maintained to transport the material to rural areas or other points of disposal.

Japanese health officials long have been concerned about the danger of disease infection from the use of human excreta as fertilizer. In December 1927, the results of a study on the bacteriological and parasitological aspects of night soil disposal were published in the Journal of the Public Health Association of Japan. The conclusion of this study was that "in order to make night soil safe from the danger of becoming the transmitting medium of various diseases by simply keeping it in a receptacle, it will take from 1 to 3 months, and that the night soil kept in winter becomes sterilized in April and May of the following year."

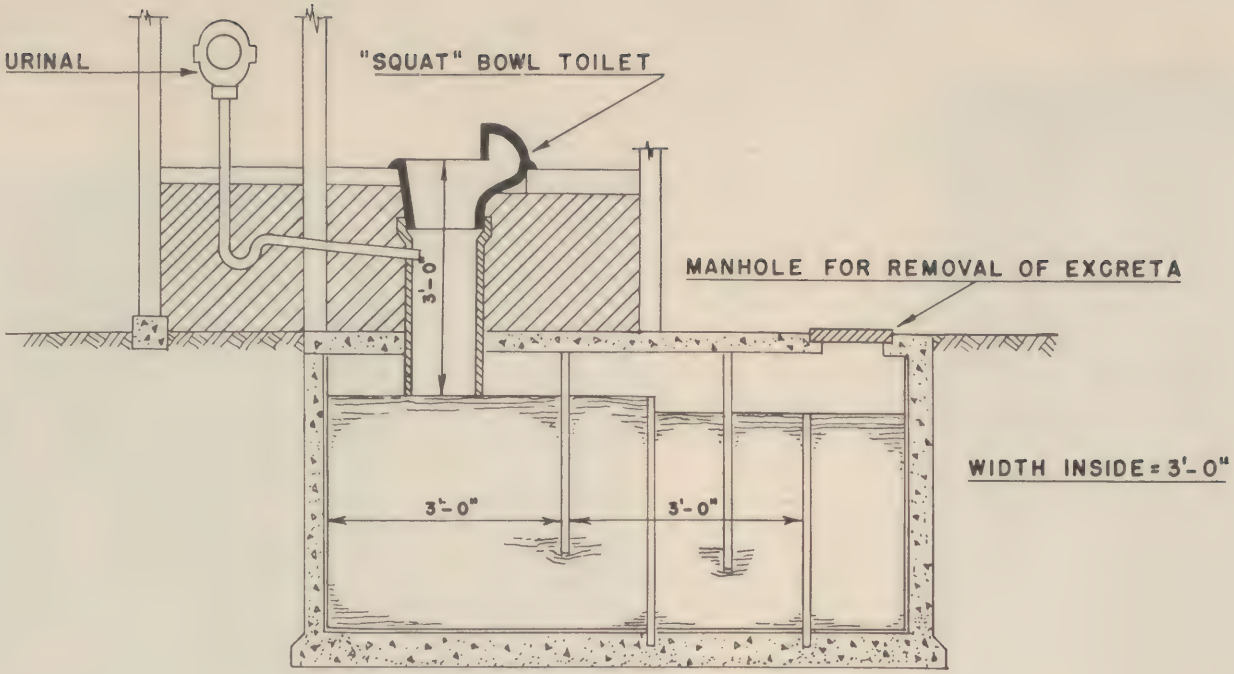
As a result of this study a new type of privy for home installation was devised with a sufficient capacity for holding the excreta for a period of about 100 days and with baffles so arranged that it was difficult to remove the material before the expiration of that time. The baffles were also purported to be effective in preventing bacteria and parasitic eggs from reaching the last compartment from which the material is removed (Figure 26).

This type of privy vault, with a capacity of about 1,000 liters for a family of 10 persons was advocated by the Bureau of Sanitation, Ministry of Health, and it was stated that "in some villages all the houses have replaced or are replacing the night-soil jars hitherto in use with our privies." "The local governments have adopted the policy of granting a fixed subsidy to those who construct the privy equipped with our improved receptacles. Although the actual number of installations of this type of privy could not be ascertained at the time of the survey, information from various sources indicated that there were not many.

During the war, prior to the bombing attacks, there was an increased demand for night soil as fertilizer because of the shortage of commercial fertilizer and the increase in the number of home gardens. Government officials advocated these "war gardens" and further advocated the use of night soil as fertilizer. In ordinary times the material taken to the farm areas was sometimes stored in concrete-lined

FIGURE 24. Transporting night soil in wooden buckets by ox.

FIGURE 25. Night soil being loaded onto barges for disposal at sea or transportation to farmlands.



PRIVY FOR HOLDING HUMAN EXCRETA 100 DAYS

FIGURE 26

FIGURE 27. Temporary wooden dwellings erected on bombed area of Tokyo.

FIGURE 28. Temporary public toilet erected on bombed area of Tokyo.

pits before using, but with the increased demand for the material both by the farmer and the city gardener, much of the material was used fresh from the toilet pit without undergoing the recommended period of 3 months digestion.

War Damages to Night Soil Disposal

As a result of the war, city collection and disposal of night soil was disrupted even before the aerial attacks began. The first effects were upon maintenance and operation of the equipment. As the supply of gasoline and fuel oil became scarce, it was necessary to reduce the number of motor trucks and boats used to transport the material. Householders made arrangements through "neighborhood associations" with farmers or other laborers for disposal of the wastes, but this service was not entirely satisfactory as the contractor or licensed collector also had difficulty with equipment and labor.

One of the city officials at Tokyo described the condition in that city as follows: "With the scarcity of materials and labor in wartime, the capital's scavenger service had suffered a remarkable weakening due to the irregular disposal of night soil by the neighborhood associations, the interruption of drainage maintenance and refuse collection, the cessation of factory trash burning, the decreased frequency of night soil and trash collections, and other such wartime blows to scavenger work."

After the aerial attacks began the situation became much worse. In the bombed cities there were heavy losses of collection equipment and available labor forces, which necessitated a further reduction in collection and disposal schedules, and in some cases halted them entirely. At the same time there was a shifting of population from the larger cities to smaller communities, causing an overload on the already diminished facilities and services in these places. As a result, night soil accumulated for weeks in the unbombed areas or it was given improper disposal by dumping into water courses or onto nearby vacant lands.

The deficiencies in labor and equipment reported by city officials at Tokyo are given in Table 90. The stated numbers of employees and conveyances required are on the basis of approximately 4 million population at the time of this survey.

TABLE 90.—*Labor and equipment for night soil and refuse disposal*

	Number required	Present number	Deficiency in percent
Employees:			
Technical assistant engineers	24	31	1
Vice-assistant engineers	56	29	48
Drivers	101	63	38
Unskilled laborers	72	111	1
Seamen	180	199	1
Porters	3,342	977	71
Conveyances:			
Motor vehicle (night soil)	205	158	23
Motor vehicle (refuse)	102	24	76
Trailer	864	540	38
Hand cart	1,200	220	82
Tug	6	6	0
Motor barge	20	14	30
Sampan	104	68	35
Dirt barge	12	2	83
Dredge	1	1	0
Floating crane	2	2	0
Motor boat	3	3	0

NOTE.—Additional contract labor required: drivers, 42; seamen, 50; unskilled laborers, 20.

These figures refer to the condition existing 3 months after the surrender, and not immediately after the bombing attacks. In the meantime there was some recruiting of personnel and equipment so that the deficiencies given are not for the lowest level that existed.

In the bombed areas toilet facilities were destroyed or damaged along with other buildings. Until these areas were reinhabited the situation probably was not detrimental, but when the evacuees came back to the areas they were faced with the same problems of waste disposal. Most of the temporary dwellings (Figure 27) that were erected had no sanitation facilities, and the few public toilets installed by the cities were not constructed satisfactorily enough to prevent a public health hazard. Figure 28 shows one of the temporary public toilets erected on the bombed-out area of Tokyo. Each of the two compartments with doors contained a wooden platform with a slot for disposal of feces, and the open compartment had a wooden urinal trough discharging onto the ground surface. No pits were provided beneath the slots and the clean-out openings were not provided with closures to prevent flies and rodents from gaining access to the contents (Figure 29). Where public toilets were not installed, the inhabitants of bombed-out areas defecated among the ruins, in some cases not even taking the trouble to find a secluded spot. Evidence of similar unsanitary practices was observed at places where the people congregated because of the lack of housing facilities.

Sewerage Systems

Sewerage systems in Japan were the combined type consisting of property drains discharging into underground conduits or sewers which conveyed the wastes to central points of disposal. The property drains were loosely covered gutters installed at ground level adjacent to the property line. They collected both surface run-off and liquid household wastes exclusive of toilet wastes. The underground conduits were sewers similar to those of Western design and were laid at a depth of 3 or 4 feet except in modern commercial districts where the buildings had basements. Buildings in the residential districts ordinarily did not have basements, hence it was not necessary to lay the sewers at a greater depth there. Lateral sewers were usually vitrified clay pipe, although precast concrete was used quite extensively. Main collector sewers generally were reinforced concrete or brick. Where pump stations were operated for lifting the sewage from lowlands, electric power was utilized and overflow drains were installed for spilling the sewage into rivers or canals in case of power failure. Stand-by pumps driven by gasoline or other power were seldom installed.

The raw sewage was low in strength, especially during the rainy season when the normally small amount of fecal material was diluted with storm water. For example, in one of the largest districts of Tokyo, where domestic sewage and a large portion of storm water was collected by the sewer system, the results of chemical analysis showed the combined sewage to have been low in volatile solids and biochemical oxygen demand (BOD) and to have had a relatively high dissolved oxygen content. The mean of three determinations for each of 11 months of 1944 is given in Table 91.

The number of sewerage systems which had existed in Japan before the air attacks could not be determined accurately. By the end of 1937 the Ministry of Health had given 49 municipalities including Naha, Okinawa prefecture, permission to construct sewers. Whether complete construction followed the granting of permission in all of these places is not definitely known. By 1940 some progress in the installation of sewerage systems is indicated by the listing of 27 additional municipalities in a United States War Department publication. Of the 76 places included in both lists, 70 were cities with populations of 30,000 or more. According to the latest information available, in 1941 there were 182 cities of this class in all of Japan. These data therefore indicate that less than 40 percent of the cities with populations greater than 30,000 had sewers or had obtained permission to construct them, whereas 92 percent of all the municipalities with sewers or permission to construct them were of this size or larger. Thirteen of the cities listed had not been recorded as having public water supplies.

Six of the cities reported to have obtained permission to construct sewerage systems were stated to have sewage treatment plants. These included four of the six great cities (Tokyo, Osaka, Nagoya and Kyoto). Sewage treatment was not provided at Yokohama or Kobe.

Tokyo—The city of Tokyo was divided into three sewer districts, each with a separate collection system and treatment plant. However, one of the plants had not been completed at the time of the survey. These districts served 50 percent of Tokyo proper and 15 percent of greater Tokyo, with a total area of 26,654 acres drained by an aggregate length of 1,211 miles of pipe. The collection system was the combined type; i.e., it received both surface water and liquid wastes from homes, commercial establishments and industries, together with the

TABLE 91.—*Chemical analysis, Tokyo-Shida-Ura plant, 1 Jan. to 30 Nov. 1944*

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Yearly average
Temperature ° C., atmosphere	5.7	4.5	10.5	11.6	18.0	25.0	26.5	30.0	29.0	23.5	15.0	18.1
Temperature ° C., sewage	7.7	6.5	9.0	10.6	16.0	20.0	21.0	24.5	24.0	19.5	14.0	15.7
pH	7.2	7.3	7.4	7.3	7.2	7.3	7.3	7.2	7.2	7.3	7.2	7.3
Solids, total (p.p.m.)[1]	2,327	1,800	3,479	1,544	1,370	2,424	1,350	1,428	928	466	752	1,624
Solids, vol. (p.p.m.)	813	650	623	445	430	919	554	542	352	210	296	530
Dissolved oxygen (p.p.m.)	4.8	5.8	4.4	3.2	3.1	1.4	1.2	0.6	0.9	2.6	2.7	2.8
Biochemical oxygen demand (p.p.m.)	120	116	84	75	73	66	53	67	67	77	83	80
Ether soluble (p.p.m.)	3.9	5.1	5.1	3.0	3.4	4.8	4.1	4.3	1.2	0.8	0.5	3.3

[1] p.p.m. indicates parts per million.

FIGURE 29. Rear of temporary public toilet on bombed area of Tokyo.

usual sanitary sewage from a few of the modern buildings. Lateral and intercepter sewers were 9 to 30 inches in diameter, and were laid in the center of streets at an average depth of 4 feet. Domestic wastes, including fecal material, were discharged into the systems from 30 percent of the houses connected. The remaining 70 percent of the houses connected had receptacles for fecal solids with overflow to the sewer. Sewage from the lowlands was pumped into the collection system. Pumping stations were equipped with automatic overflows which diverted excess storm water into the rivers and canals. Because of war interference with the completion of treatment facilities, at the time of the survey only 60 percent of the sewage was being treated and the remaining 40 percent was discharged untreated into rivers and canals.

The Shiba-ura sewer district is the largest of the three. It had 617 miles of sewers and a drainage area of 14,701 acres, which was more than one-half the total. A total population of 2,100,000 was served in this district. Treatment facilities consisted of settling and chlorination for about 70 percent of the sewage and activated sludge for the remaining 30 percent. The activated sludge portion, however, had been only 20 percent completed prior to the war and no sewage had been treated by this process since January 1945. Before the war a chlorine dosage of about 1 part per million had been applied to the effluent from the settling tanks, but chlorination had been discontinued when the chemical had become unavailable. Digested sludge is dumped into Tokyo Bay at a point about 10 miles south of Kawasaki, or about 20 miles from Tokyo.

Sewage from the Mikawashima district, which comprised a drainage area of 4,139 acres and 314 miles of sewer, had originally been treated by settling and coarse rock filtration. Later an activated sludge plant had been added for treatment of approximately 50 percent of the total flow. This phase of the treatment process was discontinued during the middle of 1945. Most of the sludge from this plant was also dumped from barges into Tokyo Bay, but a portion was dried and sold as fertilizer.

Sewage from the third district, Sunawachi, comprising about 4,700 acres and 198 miles of sewer, was intended to be treated by settling and chlorination, but the war interfered with construction of the settling tanks and the sewage was therefore discharged untreated into the bay.

Both the Shiba-ura and the Mikamashima plants were poorly maintained for several years and needed extensive repair. There was a shortage of labor for maintenance and operation and some of the units were shut down because machinery parts were not available.

Osaka—The sewerage system at Osaka is the combined type, 1,030 miles in aggregate length, draining 15,116 acres. In 1940, the population served had been estimated to be 1,854,000 (60 percent of the total) and in November 1945, it was estimated at 486,000. The number of night soil receptacles in the city could not be ascertained, but it is believed that the wastes from most of the connected houses were void of fecal solids. Treatment for a portion of the sewage had been afforded by two activated sludge plants. These plants had served an estimated population of 726,000 in 1940 (22 percent of the total) and 134,000 in November 1945.

Twelve major pump stations lifted the collected sewage from the lowlands into the interceptor sewers or into rivers and canals. In addition there were approximately 46 small pumping stations in the collector system.

The two treatment plants were approximately the same size, and consisted of the necessary basins and equipment for grit removal, sedimentation, activation and sludge storage. The plant effluent was discharged into the Yodo River and digested sludge was either dumped at sea beyond Osaka harbor or was used as fill in land reclamation.

Bomb Damage

Of the 76 municipalities reported to have sewerage systems, 52 were subjected to air attacks. The tonnage of bombs dropped on the cities varied from two to more than 16,000 tons, but most of the larger cities experienced total bomb falls exceeding 1,000 tons, resulting in the destruction of large sections of urban areas.

The principal damage to sewerage systems was the destruction of pumping stations and power lines, and the clogging of gutters with rubble from demolished buildings.

City officials at Tokyo reported damages to eight pumping stations—mostly burned-out buildings and equipment. The heaviest damage occurred on 10 March 1945, when 1,670 tons of incendiary bombs were dropped on the urban area. At Osaka, 22 pumping stations were burned or otherwise damaged.

The lack of pumping facilities because of direct damage or destruction of power lines resulted in the sewage automatically spilling into overflow lines leading to rivers and canals. Practically all the pumping stations were out of operation for several days after the major raids because of power failure, and most of the damaged buildings and equipment had not been repaired at the time of the survey.

In a few instances, sewage backed up through the house sewers into the basements of buildings. Where this occurred, it was estimated that several days expired before pumping equipment could be obtained to remove the sewage, but since there were only a few conditions of this sort, the situation could not be considered to have been a major public health hazard.

Where high-explosive bombs were used there was also some damage to collector and interceptor sewers. For example, at Tokyo, 52 breaks in collector and interceptor sewers were recorded for the period 27 January to 25 May 1945. Sixteen of these occurred in January when 170 tons of high explosives and 92 tons of incendiaries were dropped on urban and industrial areas; 15 occurred in February, when 391 tons of high explosives and 1,818 tons of incendiaries were dropped, and two in May with 18 tons of high explosives and 6,957 tons of incendiaries dropped. The damaged sewers varied in size from 9 to 60 inches in diameter and the breaks varied in length from 7 to 66 feet. In most cases, temporary repairs were made within a few days by bridging the break with timbers, and in some cases permanent repairs were completed by the time of the survey. However, in a few instances repairs had not been started yet.

Definite information on the number of breaks in sewers at Yokohama was not available, but judging by the large number of breaks in water mains, a considerable number of breaks also must have occurred in the sewerage system. City officials estimated that over 900 public buildings with toilets connected to the sewers were destroyed by aerial bombing.

Where breaks in sewers occurred adjacent to water lines a hazardous condition was created because it was possible for the water supply to become polluted by the pools of accumulated sewage. It is difficult to evaluate a hazard of this nature and it was impossible to ascertain at the time of this survey whether the water supplies had become contaminated in this manner. When high-explosive bombs fell in the streets under which water mains and sewers had been laid, breaks occurred in both pipes, and sewage could readily have been drawn into the water main when the pressure was reduced by excessive leakage. Incendiary bombs caused a similar condition to exist where property drains or gutters were installed. These drains were situated either at the ground surface or immediately below and in many cases received overflow from cesspools or night soil receptacles in addition to other household wastes. Although these wastes may not have been heavily infected with disease-producing organisms because fecal solids were absent, they certainly cannot be regarded as non-dangerous. Rubble from high-explosive or indendiary

bombed buildings fell into the drains, causing stoppages and breakage. At the same time water service lines were cracked or severed and it was quite possible that the breaks were submerged in waste water leaking from the drains. Any reduction in water pressure easily could have resulted in backflow into the water pipes.

Some damages were also incurred by sewage treatment plants, particularly when they were located near or in target areas. For example, one of the plants, Ebie, at Osaka, suffered considerable damage on 14 March 1945, when 1,733 tons of incendiaries were dropped on the urban area, and again on 26 June when 382 tons of high explosives were aimed at the Sumitomo Metal Industry and 758 tons were aimed at the Army Arsenal. During the 14 March raid, a repair house, storehouse, and gate house were burned; during the 26 June raid another gate house was completely destroyed, an aeration basin, office building and two operators' houses were partially destroyed, and windows were broken in three pump houses and one blower house. It was reported that the aeration basin had to be taken out of service, but that the other damages were not sufficient to prevent operation of the plant.

At Tokyo on 10 March heavy damages occurred to the Mikawashima treatment plant located in the northern part of the urban area. Two pump houses and a sludge barge were destroyed and two electric motors and a pump were damaged by fire. At the Sunamachi plant located on an island near the mouth of the Arakawa diversion canal, an operator's residence was burned and 1,180 feet of dike wall were destroyed when a USAAF bomber crashed into the plant on the same day. Repair work had not been started at the time of the survey.

GARBAGE AND REFUSE

Garbage and refuse collection and disposal systems suffered bomb damage similar to that inflicted upon the systems for the collection and disposal of night soil. It was reported that prior to the bombing attacks these waste materials were collected from 161 cities, each with a population of over 30,000, and from 22 large towns and villages. The urban areas in 98 of these municipalities were hit by aerial bombs, but there were 136 other municipalities bombed that apparently did not maintain garbage and refuse collection. The bomb load dropped on the latter group varied from a few tons to several hundred tons, and in most cases considerably less than 100 tons.

According to information obtained in the cities surveyed, the following description of the collection and disposal systems is typical of all cities in Japan.

Householders provided their own wooden boxes into which the material was deposited (Figure 30). Where the municipality so specified, some of these boxes were fitted with wooden covers, but in most cases the type of box was not regulated. However, the boxes were inspected frequently by the local police to assure a sanitary condition. At Kyoto they were painted once a year with a coal tar preparation as a hygienic and odor-preventative measure.

At intervals of 2 or 3 days during the summer and 5 to 7 days during the winter, the material was collected by the city or by private contractors under city supervision. Various types of vehicles were used. Horse or ox-drawn carts and man-pulled carts were employed, especially in the congested areas where narrow streets prevailed. Open-body dump trucks were also used in the larger cities. No particular effort was made to keep the organic material covered during transit.

In the larger cities the material collected in the carts was brought to centrally located transfer stations where it was separated into several categories depending upon the methods of disposal. Organic material was used as fertilizer or animal food in a few places, but final disposition usually was by incineration, land-fill or dumping at sea.

During the war, there was a marked decrease in the amount of garbage and refuse material collected. For example, at Tokyo a total of 807,201 metric tons of garbage and refuse was removed annually from 1,263,074 houses during the prewar period. This was equivalent to 1.8 kilograms per house per day, or, on the basis of the usual five persons per household, approximately 0.8 pound per capita per day. Additional data from this city for the period prior to the bombing attacks indicate a total

FIGURE 30. Typical garbage and rubbish box provided by householder.

of 1,126,837 kilograms per day collected from 803,960 houses. On the same basis of five persons per house, this amount was equivalent to approximately 0.6 pound per capita per day, a reduction of about 0.2 pound per capita or about 24 percent from the pre-war amount. Data for the post-bombing period indicate a total of 258,982 kilograms collected daily from 502,476 houses, an amount equivalent to 0.2 pound per capita, which is a reduction of 25 percent from the pre-war amount and 67 percent from the prebombing amount.

These data also show that certain portions of the material collected in prebombing days was used as food for domestic animals or as compost material whereas the remaining portion was either burned or used for land reclamation. On the basis of these figures, it may be calculated that approximately one-third of the material collected was organic in nature and would be classified as garbage. This proportion was probably lower than that for pre-war days because shortly before the aerial attacks every effort was being expended to prevent undue food wastage. Furthermore, in some places garbage from homes in the outskirts of the city was collected by farmers and used for fertilizer. The experiences of some of the larger cities in the United States indicated that the amount of garbage and refuse of a similar nature averaged twice the amount collected in Japanese cities, and that the organic or garbage portion was about two-thirds of the total. Hence the amount of organic material, which is the important portion insofar as sanitation is concerned, accumulated in Japanese cities during the prebombing period was approximately one-half the amount collected in United States cities. After the bombing attacks the amount of this material dropped to about one-third of that collected in United States cities.

In addition to the actual reduction in the quantity of refuse material another reason was apparent for the decrease in the amount collected during the war, both before and after bombing. As the war progressed, it became increasingly difficult to keep a suitable labor force and to maintain the collection equipment in a serviceable condition. An acute shortage of fuel oil for motor trucks developed and most

FIGURE 31. Garbage and rubbish incinerators at Kyoto.

of the cities had to discontinue garbage collections by truck. Horse-drawn wagons or the two-wheeled carts pulled by manpower were substituted when they were available but in most cases it was necessary to get along with a minimum of equipment. For example, Kyoto, an unbombed city, operated 20 motor trucks, a horse-cart and 20 man-pulled carts before the war, but during the summer of 1945 all motor trucks were inoperative and the collections were made by a few additional horse-drawn wagons and carts. It was estimated that 330 tons of material were collected daily before the war whereas the amount dropped to 50 tons per day at the time of this survey, and most of this was from Army of Occupation billets.

Disposal before the war was by burning in two modern-type incinerators (Figure 31), but as the quantity of material had diminished, operation of the incinerators was discontinued in 1943. At the time of the survey, the small quantity of refuse collected was buried in dump grounds.

Aerial bombing caused an additional drastic curtailment in the collection and disposal of this material. When large sections of urban and commercial areas were hit by incendiaries, the resulting fires destroyed vehicles, transfer stations and maintenance shops. Incinerators located in bombed areas such as at Tokyo were also destroyed. This destruction coupled with the depletion of labor forces necessitated the discontinuation of collections for periods of days or weeks at a time after the raids. At Yokohama, collections had not been resumed at the time of this survey.

During these periods of interrupted collections, the individual householders were expected to dispose of the material in any suitable manner. Burning, burial or dumping on vacant areas were the usual solutions to the problem. Despite these expedients, the city officials interviewed were of the opinion that since there was a decided reduction in the amount of material from each household, these methods were satisfactory in preventing the development of a seriously insanitary condition.

MILK SUPPLY

The production, handling, processing and delivery of whole or sweet milk was not an important health problem in Japan. Milk was not used as an article of diet by the general population and its use was largely confined to infants and pregnant women. According to Japanese health officials, the milk supply of the cities surveyed was pasteurized prior to delivery, and was delivered in small individual bottles holding approximately half pint. Pasteurization methods were uniform, 30 minutes

holding at 63° C. The health authorities exercised sanitary control over the industry.

According to reports obtained from the Ministry of Health and Social Affairs, the quantity of milk, including goat's milk, was 4.08 liters per year or about 0.03 pint per day per inhabitant. The last report prior to the war gave the amount of milk handled in the prefectures in which the six large cities are located as follows:

TABLE 92.—*Quantity of milk pasteurized and daily per capita consumption, six prefectures, 1938*

Prefecture	City	Gallons per day	Pints per capita per day based on total population
Tokyo	Tokyo	31,700	0.034
Osaka	Osaka	10,500	.018
Kanagawa	Yokohama	8,200	.030
Aichi	Nagoya	6,100	.015
Hyogo	Kobe	4,900	.012
Kyoto	Kyoto	4,200	.019

Source: Annual Health Report—Ministry of Health and Social Affairs, 1938.

Prior to the war, Tokyo obtained its milk supply from 85 dairies having a total of 5,000 cows. Prior to the bombing, 1,740 gallons per day were pasteurized in six plants. Through destruction of four plants and reduction in milk production, the pasteurized supply after the bombing was 80 gallons per day.

FOOD SANITATION

The destruction of abattoirs and food processing establishments in the target areas interrupted such food inspection service as may have normally existed. This inspection service was further curtailed by the development of the black market through which moved much of the foods that otherwise would have been inspected. Sanitary inspection of places where foods were sold or were prepared and served was a function of police and was not modified throughout the war.

MOSQUITOES AND FLIES

With the exception of Osaka, no mosquito control activities were carried on in any of the cities visited. Mosquitoes were reported prevalent during the summer of 1945 although no information as to the species was available. The large number of small static water containers maintained for fire fighting in case of bombing and numerous pools of water created by leaky water service pipes after the air raids provided excellent breeding places for mosquitoes and accounted for the increased prevalence reported in 1945.

Malaria was not a health problem in the larger cities of Japan, but health officials were somewhat fearful that the disease would be introduced by soldiers returning from the Southern Pacific Islands. Anopheles mosquitoes were present in various localities and of this group *Anopheles sinensis* was the most important vector of malaria. The bombings produced conditions which are favorable to mosquito colonization in general but which are not favorable for this species of Anopheles. Malaria was therefore eliminated as one of the diseases that might be affected by bombing.

Dengue fever occurred in Osaka in increasing proportions after the beginning of the war and reached epidemic proportions during 1944. Seven hundred and twenty-six cases were reported in 1945, 1,578 in 1943, and 37,160 in 1944, with the actual number of cases undoubtedly greater. In September 1944, the peak month for that year, 25,039 cases were reported. During the period January to November 1945 only four cases were reported. The failure of the disease to appear again during the summer of 1945 indicated that some inimical factor other than the limited mosquito control exercised by the city was operative.

The mosquito vector of dengue in Japan is said to be *Aedes albopictus*. The large number of small static water containers previously referred to furnished ideal breeding places for this species of mosquito, which was known to be present in the city. The widespread fires from the incendiary bombing during the early summer months should have destroyed almost all the mosquitoes in areas where production was undoubtedly most prolific, together with the evacuation of people from the same area, may explain the relative freedom from dengue during the summer of 1945.

The common housefly is a vector in the spread of dysentery, typhoid fever and other intestinal diseases. Flies are numerous in Japan and the local governments conduct active campaigns to control them. Buildings are not screened, how-

ever, and with the extensive use of night soil as fertilizer direct avenues are present for transmitting disease organisms to food. These insects, therefore, probably were instrumental in the increased incidences of enteric diseases discussed under sewage disposal.

RODENTS

The incendiary bombing appeared to have been quite effective in reducing the rat population of cities, as no rats were observed in the burned-out areas. It is probable, even in the absence of substantiating data, that the percentage reduction in rat population was approximately that of the city destroyed. Murine typhus, a disease transmitted to humans through the rat flea, had been reported in Japanese seaports. Vital records did not differentiate between this type of typhus and that transmitted by the body louse and generally referred to as epidemic typhus. Based on the seasonal occurrence of the disease in Tokyo, as shown by the records as well as statements by the health authorities, it was assumed that the disease in that city was the murine type. The records showed that this disease increased in Tokyo from what was probably a normal condition in 1940 to considerable proportions in 1944, indicating an increasing reservoir of infection in the rat population. In the absence of effective rodent control measures, a greater prevalence of the disease would have been expected in 1945, instead of the decreased incidence that occurred. Table 93 presents these records.

Since control measures were not carried on in Tokyo, some other factors involving a marked reduction in infected rodents must have been active. Foci of murine typhus infection have generally been found in areas where foodstuffs are handled and stored. Such areas were within the areas under attack in February, March, April and May 1945, and a marked reduction in rat population with a corresponding reduction in numbers of foci of murine typhus infection must have occurred then. This reduction in infected rats together with the evacuation of practically all persons from the area probably accounts for the reduction in the disease incidence during 1945.

SUMMARY AND CONCLUSIONS

The bombing of urban areas caused large-scale evacuation of the population from the attack areas. This amounted to approximately 27 percent of the population of Honshu, Kyushu and Shikoku, exclusive of that of the target areas. This evacuated population distributed itself in a haphazard manner throughout the smaller communities of the three islands. The impact on these communities modified their normal services and functions and was reflected in the general health conditions of the nation. Dysentery, the most sensitive index of changed sanitary conditions, showed a marked increase in 1945 over that of the four preceding years (Figure 44).

Water Supply

Bomb damage to waterworks was confined largely to distribution systems. Main pumping stations and treatment plants were not damaged enough to interfere much with their operation nor their ability to supply an adequate

TABLE 93.—*Typhus cases and deaths—Tokyo (by years)*

	1940	1941	1942	1943	1944	1945 (January–November)
Cases	2	20	23	59	672	26
Deaths	0	3	6	7	187	0

Typhus cases and deaths (by months for 1944 and 1945)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1944:													
Cases	1	4	2	39	350	224	37	6	2	5	0	2	672
Deaths	0	0	2	4	71	84	16	2	3	3	2	0	187
1945:													
Cases	2	0	3	2	14	3	1	1	0	0	------	------	26
Deaths	0	0	0	0	0	0	0	0	0	0	------	------	0

quantity of water. Power failure, due to bomb damage, however, did interrupt the continuity of the supply in some instances.

Destruction of pumping plants at the source and destruction of treatment plants of the public water supply would appear to be the most effective way of crippling the fire-fighting activities and interrupting industrial and other municipal functions in the city under attack.

Due to the lack of treatment chemicals during the war years there was some deterioration in the quality of the water supplied. The bombing did not effect this condition and the water delivered by the treatment plants after the attack period probably was of much the same quality as that delivered prior to the bombings.

There was extensive bomb damage to the distribution system, mostly to the house service pipes. Water mains were broken by high-explosive bombs but generally were repaired promptly. The incendiary bombing, with destruction of buildings by fire, left service connections in a damaged and leaky condition. Loss of water through these broken services together with that from undetected leaks in mains necessitated the maintenance of a supply of water nearly as great as that required prior to the bombing despite the fact that the number of consumers had been reduced by 50 percent or more in almost every instance. This excessive and continuous loss of water caused reduced water pressure in the system and deprived some undamaged areas of a constant water supply. Other areas were likewise affected due to power failure or destruction of booster pumping stations.

The low and varying water pressures coupled with direct openings into the system through leaky service connections presented optimum conditions for backflow and the introduction of pollution that may have been present due to sewerage breaks. The outbreaks of typhoid in epidemic proportions occurring at Kobe, Nagoya and Yokohama, and of dysentery at Nagoya, probably were due to these causes. The same potential danger of contamination of the water in the distribution system existed in all cities attacked. The translation of the potential to actual danger requires the simultaneous occurrence of two or more of such conditions. This apparently occurred in these three cities and not in the other two up to the time of this survey.

Since disease outbreaks from contamination of the public water supply occurred in three of the five cities for which records were obtained, it may be assumed that similar conditions existed with proportionate effects in the other bombed cities having public water supplies.

Because of the existence of private wells actual shortages of water for domestic purposes did not occur in any of the cities attacked. On the whole, the water from these wells cannot be considered of safe bacterial quality. However, as these wells were generally used in conjunction with the public supply, any sharp increase in either the typhoid or dysentery rates after the bombings cannot be attributed to the use of well water alone.

Sewage and Garbage Disposal

The universal practice of salvaging human excreta (night soil) for use as fertilizer presented special problems. Its collection and disposal created conditions hazardous to the public health both before and after the air attacks. Systems for the collection and disposal of this material deteriorated during the war even before the bombing attacks, and frequency of collections was reduced. After the attacks, collections were discontinued entirely for several weeks in some of the cities. At the same time the shifting of populations to unbombed areas and to other cities actually created a need for more frequent collections. Accumulations of the material in the inhabited areas afforded reservoirs of disease-producing organisms that could readily be transmitted to the people by flies and other vectors. The insanitary conditions resulting from this lack of collection and proper disposal are reflected in the country-wide increase of dysentery during the year 1945 over the three preceding years. Such insanitary conditions also may be responsible to some extent for the large number of cases of dysentery in Nagoya and typhoid and paratyphoid in Nagoya, Kobe and Yokohama. Also favorable to the spread of disease was the use of undigested night soil on war gardens.

In those cities where street sewers and property drains were installed, bomb damage caused leakage of polluted water into craters or other depressions where it could be drawn into the

water supply through breaks in mains or house service pipes. Although the absence of fecal material from sewage collection systems somewhat lessened the danger of disease from pollution in this manner, the situation could not be regarded as without hazard. The probability of disease epidemics resulting from these conditions has already been discussed in the foregoing conclusions relative to water supplies.

Damages to sewage pumping stations and treatment plants were not significant from a public health standpoint because they did not cause seriously insanitary conditions.

Considering the fact that garbage and refuse collections had diminished throughout the war, it is difficult to evaluate the effects of bombing on the disposal of these materials. From the standpoint of public health the most serious factor in allowing the material to accumulate was the matter of food supply for rodents and breeding places for insects. However, the amount of material lessened throughout the war years so that although the frequency of collection was reduced it was probably sufficient to prevent the development of seriously insanitary conditions. After the aerial attacks, when collections were discontinued entirely, there was a further reduction in the total amount of the material and even though the householders had to dispose of it themselves by burial or burning, the situation was probably no worse than before. Nevertheless, even small accumulations were undesirable and contributed to a generally unsatisfactory condition.

Food Sanitation

Although the sanitary control over the production, processing and delivery of milk was affected by the bombing this was not a public health factor because milk is not a staple article of diet in Japan. Sanitary control over the processing of food or the preparation and serving of food in public places was disrupted after the air raids. This, together with the development of the black market, caused a deterioration in the effectiveness of such food sanitation activities as were normally carried on.

Pest Control

Malaria was not a public health problem in the areas surveyed although the danger of its introduction by returning soldiers was recognized. With the exception of Osaka, where dengue fever in epidemic proportions existed in 1944, no attempt was made to control mosquito reproduction. It was noted that a considerable increase in mosquito reproduction occurred during the summer period where conditions produced by bombing were ideal. The destruction of rats was believed to be approximately proportional to the area of the city destroyed. It was believed that the reduction in murine typhus during 1945 in Tokyo may be attributed to the reduction in the rodent foci and the removal of the population from the focal areas.

V. INDUSTRIAL HEALTH AND HYGIENE

ORGANIZATION, REGULATIONS AND FUNCTIONS

Information concerning the effects of war and the air raids upon the health and efficiency of workers in Japanese war industries was obtained from several sources. Inspections of large industrial areas and of representative ordnance plants, shipyards, machine shops, storage battery factories, airplane factories and electrical parts factories revealed fairly complete destruction of many key industrial installations. Indeed, in a few target areas, it was somewhat difficult to find a sufficient number of undamaged war industries and plant hospitals to obtain a comprehensive picture of operations before the air raids. Those investigated, however, amply supported the assertions of health officials that little had been done to promote industrial health and efficiency and to protect employees from disabling illnesses and injuries.

General information concerning the effects of war, and later the air raids, upon industrial health was obtained in Tokyo from the Ministry of Health and Social Affairs, the Institute of Public Health, the Institute of Infectious Diseases, the Institute for the Science of Labor, and the Municipal Health Department, and also from the prefectural and municipal health and labor officials of Nagasaki, Hiroshima, Osaka, and Kyoto. In many instances, these data were meager because of the loss of records by bombing or evacuation of central offices, and because of wartime bans against extensive gathering of certain routine statistics. Nevertheless, it is believed that a representative picture was obtained of wartime conditions and effects of the air raids in target areas upon industrial health problems.

In the official reports of the prewar years and the early years of the war, the industrial health and hygiene functions and organizations of the national and prefectural governments appeared reasonably adequate. The Factory Act for Japan applied to all factories with more than 10 employees or those engaged in dangerous work. It was promulgated on 28 March 1911, and later was amended by Imperial Decrees and departmental regulations. It contained the following provisions for protecting the workers health:

1. The occupier of a factory shall not employ young persons under 16 years of age or women for more than 11 hours a day.

2. The occupier of a factory shall not employ a young person under 16 years of age or a woman between the hours of 10 p.m. and 5 a.m.

3. The occupier of a factory shall grant at least two rest days a month, and a break of not less than 30 minutes during the period of employment if the said period of employment exceeds 6 hours a day, or not less than 1 hour if the period of employment exceeds 10 hours a day, to persons under 16 years of age and women.

4. The occupier of a factory shall not allow persons under 16 years of age and women to perform any dangerous or unhealthy work such as to take off the driving belts or to work in places where dust or powder or injurious gas is generated.

5. The occupier of a factory shall not employ a woman for 4 weeks before childbirth if she requests rest days during that period nor a woman within 6 weeks after childbirth.

6. The occupier of a factory shall cause a doctor to examine the worker's health condition at his employment and thereafter regularly at least once a year and shall take suitable measures to protect his health according to the result of the medical examination.

7. The occupier of a factory shall provide necessary equipment to protect worker's health in unhealthy workplaces. He also shall provide first-aid equipment for the places where dangerous work is performed.

8. The occupier of a factory employing over 100 workers shall nominate a factory physician to take care of hygienic conditions of the factory and annexes and to take care of the health of workers.

The Mining Act, promulgated in March 1905

to protect the health of miners contains provisions similar to those listed above. On 15 June 1943, however, articles 1, 2, 3 and 4 of these acts were suspended because of the urgency of production needs, and remained ineffective until restored along with other protective labor laws by the Supreme Commander for the Allied Powers on 11 November 1945. This policy of wartime abrogation of regulations intended to protect the health and efficiency of workers in factories and mines was in contrast to the wartime policies for further protecting industrial employees recommended by the United States Government to its industrial establishments.

The Ministry of Health and Social Affairs was organized in 1938 as the central administative organization for public health matters. This ministry, an outgrowth of the Central Sanitary Bureau of the Ministry of Home Affairs, was formed because of the stress of the undeclared war in China, and the growing recognition of the seriousness of the tuberculosis problem which was aggravated by the very large number of rural inhabitants being brought into the city factories. This ministry, administratively patterned somewhat after the public health services in the United States, provided a section on chronic infectious diseases and industrial hygiene for administration and control of the industrial hygiene program throughout the prefectures, and a section of industrial hygiene in its research and training center, the Institute of Public Health, for investigation and research upon industrial hygiene problems. This research center had been engaged in wartime investigations of all kinds of industrial hygiene problems including laboratory research upon high humidities and temperatures, occupational diseases, low temperatures, nutrition, hours of work and fatigue. A special study of fatigue with relation to long hours of work was begun in the summer of 1944 because of excessive illness and absenteeism in war plants. First, methods had to be devised for adequately measuring fatigue and the usual difficulties were encountered in solving this complex problem, so no definite conclusions were reached. Studies were completed, however, in April 1944, relating to sleep and rest of factory workers.

In the provinces, under the administrative control of the prefectural governors, there were dual health functions in the labor section of the police department and in the health department. These functions were apparently not clearly defined and their administrative responsibility to the central ministry seemed to vary from one province to another. In general, it appeared that industrial hygiene sections in the prefectural health departments acted in a consultative capacity to the medical inspectors of factories in the labor section of the police department, and made studies of unusual cases or prevalence of occupational diseases. The medical inspectors were supposed to visit the factories at regular intervals and see that working conditions were satisfactory, that the sick and injured workers were properly treated, and that the factory dispensaries, first-aid stations and hospitals were properly equipped and staffed. This work was under the administrative control of the local governor, with advisory direction and some administrative control from the Ministry of Health. In addition, the police had responsibilities for many of these functions in subprefectural groups, or police districts, and in towns and villages.

This complex division of responsibility and functions on industrial hygiene problems at the prefectural and subprefectural levels was difficult to elicit from the various health officials interviewed, as there was considerable confusion regarding specific functions. In one highly industrialized prefecture, the health and police department physicians outlined almost identical functions. When this was mentioned to the medical inspector in the police department, he said he was supposed to coordinate these activities but the cooperation was "not so good". In addition, there had generally been a serious depletion of the personnel of already understaffed health departments as the war progressed, and the loss of many important records by air raids and the transferral of key personnel further lessened the efficiency of the remaining organizations.

As shown in Table 94, on 22 February 1944, there were more than 31 million Japanese gainfully employed, of whom 18 million were males and 13 million were females, according to data gathered by the Manpower Division of the Sur-

TABLE 94.—*Population, armed forces, and civilian labor force by sex and activity, Japan proper 1 Oct. 1930; 1 Oct. 1940; 22 Feb. 1944*

[In thousands]

Classification	1 Oct. 1930			1 Oct. 1940			22 Feb. 1944		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Agriculture and forestry	7,735	6,396	14,131	6,619	7,223	13,842	5,569	7,807	13,376
Fishing	515	53	568	476	67	543	380	84	464
Mining	271	45	316	529	69	598	681	124	805
Manufacturing and construction	4,428	1,448	5,876	6,178	1,954	8,132	7,243	2,251	9,494
Commerce	3,406	1,500	4,906	3,006	1,876	4,882	1,127	1,237	2,364
Transportation and communications	907	38	945	1,214	150	1,364	1,385	265	1,650
Government and professional	1,369	393	1,762	1,515	680	2,195	1,895	1,005	2,900
Domestic service	92	710	802	39	670	709	58	415	473
Others	64	7	71	154	64	218	73	58	131
Occupied	18,787	10,590	29,377	19,730	12,753	[2] 32,483	18,411	13,246	31,657
Unoccupied	13,360	21,470	34,830	15,142	23,795	38,937	[6] 16,182	[6] 25,085	[6] 41,267
Civilian population	32,147	32,060	64,207	34,872	36,548	71,420	[5] 34,625	[5] 38,439	[5] 73,064
Armed forces	243		243	[1] 1,694		[1] 1,694	[4] 3,980		[4] 3,980
Total population	32,390	32,060	64,450	36,566	36,548	73,114	[3] 38,605	38,439	[3] 77,044

[1] Information obtained by census takers from closest civilian relative. Adjusted on basis of information obtained by USSBS from Japanese Army and Navy officials. Separation of those in Japan proper and those overseas was not possible.

[2] Excludes those officially designated "foreigners", numbering about 40,000 in the civilian population.

[3] Sum of the civilian population (actual census enumeration) and armed forces (estimated). This overstates the size of population of Japan proper since the armed forces include some persons recruited from territories outside of Japan proper.

[4] Estimated from data supplied by Japanese Army and Navy officials. Includes all members of Japanese armed forces, due to impossibility of segregating those from Japan proper. Also includes some females (number unknown).

[5] Figures are subject to revision, since final figures have not yet been prepared by the Japanese census authorities. Several differing sets of statistics have been drawn from the 1944 enumeration by various Japanese agencies using differing principles of coverage, classification, etc., without adequate explanation. Reconciliation of these differences, and of certain internal inconsistencies, must await a recomputation of the basic returns. The figures presented here are considered the most reliable of the various versions. Also, it must be noted in comparing 1944 with other years, that the 1944 census officially excluded from the count the population of certain administrative subdivisions of Tokyo-to and Hokkaido; the population of these districts in 1940 was approximately 24,000.

[6] The figures for the Occupied and Unoccupied in 1944 are subject to a bias relative to the corresponding figures for 1930 and 1940. Since the census of 1944 was taken in February of that year, before the majority of school graduations, whereas the censuses of the earlier years were taken in October in each case, after the graduations, the count of the Occupied in 1944 is understated in the younger age groups.

Source: 1930: All data from actual census enumerations as submitted by the Japanese Cabinet Bureau of Statistics.

1940: Total population from census enumerations as submitted by the Japanese Cabinet Bureau of Statistics.
Armed Forces estimated from census enumeration and data submitted by Japanese army and navy officials.
Civilian population and Occupied from actual census enumeration as submitted by Labor Bureau, Ministry of Welfare.

1944: Total population estimated (foot note 3).
Armed forces estimated from data submitted by Japanese Army and Navy officials.
Civilian population and Occupied from census enumeration submitted by Labor Bureau, Ministry of Welfare.

vey from the Labor Bureau, Ministry of Health and Social Affairs. Of these, 7,243,000 males and 2,251,000 females were employed in manufacturing and construction, and 681,000 men and 134,000 women in mining. Agricultural and forestry led the list with more than 13 million persons, while commerce, transportation and communications, and government and professional groups accounted for about 2, 2, and 3 millions, respectively. The 9,494,000 persons employed in manufacturing and construction industries in 1944 were considerably in excess of the 8,132,000 persons so employed in 1940 and the 5,876,000 persons in 1930 in this category. Women constituted about 25 percent of the total in all three of these periods, a fact that is difficult to explain in view of the wartime demands of the armed forces for men. Table 94 shows complete data and estimates of employment, subject to certain qualifications as set forth in the manpower report of the Survey.

According to Ministry of Health officials, there were 4,631 industrial physicians in 1937, of whom 11.4 percent were employed full-time by the factories. Of these, 445 physicians, of whom 55.7 percent were on a full-time basis, were in the large factories employing more than 1,000 workers. During the war, the number of industrial physicians decreased because of the demands of the armed forces, but many of the new ordnance plants employed more physicians than did the old-line factories. In 1944 the Ministry of Health recommended that groups of small factories combine their resources to have the part-time services of a physician who would be connected with the local health center, and that all large factories with more than 1,000 workers employ a full-time physician; however, these recommendations were not generally followed. Another recommendation suggested that the duties of the physician in charge of the factory hospital be separated from those of the factory physician engaged in preventive work.

SPECIAL SURVEYS IN OSAKA

Recent data on industrial physicians were available from the industrial prefecture of

Osaka. This "Pittsburgh" of Japan had 16,600 factories with 660,000 employees to which the Factory Act applied. Of these factories 604 had more than 100 employees. Only 41 factories had their own hospital and medical staff; and 13 others had full-time physicians. To comply with the Factory Act, 639 other factories arranged for the part-time services of physicians, but 30 of these physicians each served from 4 to 17 factories, 30 others served 3 factories each, 97 served 2 factories, and 324 gave part-time services to one factory. The 1 to 500 ratio of physicians to factory workers was favorable, however, as compared to the 1 to 1,200 ratio to the general population.

The factories were among the principal employers of public health nurses who were required to have finished middle school (11 years) and 2 years of hospital training that included such subjects as biology, economics, statistics, and industrial hygiene. However, as the supply of public health nurses was very limited, they generally employed the lower grade of nurses who had 2 years of general hospital training after primary school (6 years).

Because current general information concerning the effects of air raids upon industrial health problems was lacking in Osaka prefecture, the medical inspector assisted the Survey by sending industrial nurses to 51 of the large local factories to collect data. These 51 factories employed 64,000 workers before the air raids, and manufactured steel castings (7), diesel engines (3), electric motors (4), machinery (6), ships and vehicles (6), airplane parts (5), ammunition (8), plastic toilet articles (8), textiles (2), and portland cement (2). The principal occupational diseases had been welding conjunctivitis, eye infections from foreign bodies, impaired hearing, and lead poisoning. It was stated that, before the air raids, efficiency had been impaired by long hours and black-outs, and that tuberculosis and malnutrition due to food shortages and distribution difficulties had been important health problems. These factories had 42 full-time doctors in 19 plants, 40 part-time doctors in the remaining 32 plants, 142 nurses in 38 plants, 19 industrial hygiene engineers (probably safety inspectors) in 14 plants, and 54 other medical department personnel in 11 plants. Over-all data on sick absenteeism were not available but tuberculosis, beriberi, respiratory diseases, and injuries were listed as the leading causes of absenteeism. The air-raid protection for workers consisted of bomb shelters and steel helmets, and a few gas masks.

During this survey of 51 factories, emphasis was placed upon the effects of the air raids which occurred mainly in the spring of 1945. Thirty of the plants visited, or 60 percent, had been destroyed. It was reported that only 0.3 percent of the workers in these 30 factories had been killed and 0.8 percent injured, possibly because most of the raids were at night, because of the air-raid shelters, and because 70 percent of the bomb tonnage in this city was incendiary. In addition the homes of 21 percent of these workers were destroyed. Nineteen percent of the plant employees were thrown out of work. There were no casualties among the medical department personnel but about one-fifth of the doctors and nurses were released because of shutdowns, and 13 of the 37 plant dispensaries were destroyed, 11 by fire and two by high explosives. Medical services were reported destroyed in 15 plants, inactivated in 16, passable in 14 and active in six factories.

It was reported that the air raids produced a marked increase in sickness absenteeism because of beriberi, malnutrition, overwork and loss of sleep. Respiratory and digestive diseases evidenced little apparent change. Absenteeism owing to other causes such as air-raid evacuation, foraging, traffic accidents, and fear of the raids, was greatly increased. Food supplies were stopped in five of these factories, and decreased in the remainder even before they were destroyed. Other effects of the air raids that further lowered production included the disruption of private medical services, increasing tuberculosis, the prevalence of eczema, scabies, and other skin diseases because of the lack of soap and hot water, great difficulties in reaching work, and stoppages of light and heat in the factories.

Other fairly recent data concerning the medical facilities of factories in typical large areas were obtained from a report of an investigation of 4,603 factories in Osaka prefecture employing 466,995 workers on 10 February 1945. Of these factories, only 20 or 0.4 percent had

hospitals or dispensaries and a full-time physician, 78 or 1.7 percent had a full-time physician and consulting rooms, 5 percent had consultation rooms with a part-time physician, 18 percent had part-time physicians but no medical equipment, and 75 percent had no physicians or medical equipment. It was stated that only about 2 percent of the factories had adequate medical services and equipment and these were largely munitions factories. Also, only 2 percent of these factories had facilities for physical training of employees.

ABSENTEEISM

Data regarding absences from work in war industries were extremely limited for the last 2 years of the war. From the available data and many statements received from health and factory officials, it appeared that factory attendance fell off increasingly with the difficulties caused by lessened food supplies, poor local transportation to work, deteriorating health supervision, long hours of work, and increasing illness such as tuberculosis, colds, malnutrition, dysentery, diarrhea, and chronic fatigue. In the target areas, the air raids increased these difficulties immeasureably, and lead to sufficient absenteeism (30 to 50 percent) to be a major production problem.

In many war industries, the usual work day for adults was 12 hours, with only one or two holidays a month. For children, the 10-hour day, 5-day week was common, and early in 1944 it became a 6-day week. Many men worked 14, 16, or even more hours per day.

In the light of past experience in the United States, Great Britain and Germany, these prolonged hours of work alone would be expected to result in impaired efficiency and increased absenteeism. For example, H. M. Vernon of the British Ministry of Health has pointed out that industrial researches have shown the cardinal error committed by many employers of labor during World War I was the imposition of excessive hours of work. Employees who had been working from 48 to 54 hours a week were required to work 70, 80 and even 90 hours a week in an effort to increase the production of war materials. Investigations showed that because of increasing sickness, accidents, and spoilage of materials, production suffered heavily with these excessive hours of work. Illness was found to be the cause of twice as much lost time among both men and women who worked long hours as among those who worked relatively short hours.

Kossoris, in summarizing the British investigations, showed that men engaged in the heavy manual labor of sizing fuse bodies increased their total weekly production 22 percent when the weekly hours of work were decreased from 66.7 to 56.6 (15 percent). These results were obtained over a 13-month period. The production increase was attributable to a 39 percent increase in hourly output and a decrease in wasted time from 8.5 hours per week to 5.3 hours. Also, in a 93-week study of 100 experienced female operators turning aluminum fuse bodies on capstan lathes, it was shown that by reducing the weekly hours in the plant from 75.5 to 63.5 there was no decrease in production, and that when the hours of work were further reduced to 55.3 there was a 1.3 percent weekly increase in production.

A report from the British Industrial Health Research Board gave the results of an investigation made in a number of munitions factories during the period from the outbreak of the recent war until the end of June 1941. This report concluded in part:

> 1. The results of this inquiry show that the time lost by factory workers through sickness, injury and absence without permission, when undisturbed by extraneous factors, varied with the weekly hours of work. It was usually low when the hours of work were less than 60 per week, but increased as the hours increased up to 75.
>
> 2. The findings suggest that, over an extended period, the weekly hours of work should generally not exceed 60 to 65 for men and 55 to 60 for women.

A committee appointed in 1942 representing eight United States governmental agencies directly concerned with furthering war production studied all available evidence on hours of work and concluded:

> . . . that for wartime production the 8-hour day and 48-hour week approximate the best working schedule for sustained efficiency in most industrial operations. While hours in excess of 48 per week have proved necessary in some instances due to a limited supply of supervisory and skilled manpower, there has been some ten-

dency to continue longer schedules after sufficient opportunity has been afforded to train additional key employees.

"Plants which are now employing individual workers longer than 48 hours a week should carefully analyze their present situation with respect to output and time lost because of absenteeism, accidents, illness and fatigue. They should re-examine the possibilities of training additional workers now, in order to lessen the need for excessive overtime during the long pull ahead. As rapidly as is feasible these plants should introduce the hours-schedules that will maintain the best possible rate of production for the duration."

This committee also advocated that one scheduled day of rest for the workers and supervisors, approximately every seven days, should be a universal and invariable rule, and pointed out the value of regular vacations.

Despite this experience and the action taken by Western nations, the Japanese governmental and military authorities required their war workers to work extremely long hours. During the latter part of the war many factories permitted only 1 day off per month for rest and recreation. On two occasions the Ministry of Health unsuccessfully attempted to convince the military authorities to reduce the work day to 9 hours in the interest of efficient production.

During the war, the Japanese Ministry of Health collected data on sickness absenteeism lasting 1 day or longer for 340 factories in the six industrial prefectures of Tokyo, Kanagawa, Aichi, Osaka, Kyoto and Fukuoka. These illnesses were based on physicians' certificates in connection with health insurance, and are shown in Table 95. For comparison, data are shown for an American public utility for the 5 years, 1940–44. This company had been reporting sickness absenteeism for some time and had been found to be fairly representative of American industry.

TABLE 95.—*Average daily percentage of workers disabled because of illness lasting 1 day or more in 240 Japanese factories and a United States public utility*

	Japanese factories		American public utility	
	Males	Females	Males	Females
1937	2.5	2.8		
1938	2.8	3.4		
1939	2.9	4.0		
1940	3.2	4.4	2.2	2.9
1941	3.3	4.3	2.4	3.4
1942	5.7	6.0	2.7	3.2
1943	7.2	9.0	3.1	3.8
1944			3.8	4.3

It may be noted from Table 95 that the sickness absenteeism rates for Japanese males had more than doubled from 1937 to 1942, and had tripled by 1943. The rates for females doubled and tripled during the same two years respectively, as compared with 1937. It may also be observed that these rates for both Japanese males and females were about 50 percent higher than those for United States males and females in 1940–41, about 100 percent higher in 1942, and had increased to 130–150 percent higher in 1943. It is believed that a much greater difference in Japanese and American experience would have been evident if Japanese data were available for 1944–45, as Japanese officials were unanimous in stating that absenteeism had increased very seriously through 1944, and even more after the 1945 air raids.

The leading causes of the sickness absenteeism in the above study were investigated for 1942 and were found to be as follows:

TABLE 96—*Leading causes of absenteeism—1942*

	Percent.
Pulmonary tuberculosis	20
Gastrointestinal disturbances	13
Colds	10
Beriberi	8
Pleurisy	6
Bronchitis	5
Conjunctivitis	3
Neuralgia	3
Other	32

It is evident that respiratory diseases accounted for a large proportion of all sick absentees. In addition to tuberculosis being given as the leading cause for absenteeism, it was also stated that many more cases of tuberculosis were classified as pleurisy or bronchitis. The influence of malnutrition was demonstrated by the prevalence of beriberi and gastrointestinal disturbances, as well as by its known effects on tuberculosis.

An investigation of the nutrition problem was made in 1942 by the Institute of Public Health, Section of Industrial Hygiene in 120 representative war factories in 4 industries. The investigation covered the hours of work, attendance, sickness absenteeism, body weight, tuberculosis, beriberi and gastrointestinal diseases. These factories all had more than 1,000 employees and were privately owned. The per-

centage of average daily attendance for the years 1936–42 is shown in Table 97.

TABLE 97.—*Percentage of attendance of factory workers in four industries, 1936–42*

Industry	Sex	1936	1937	1938	1939	1940	1941	1942	Average
Metal	Male	91	91	89	88	89	88	86	89
	Female	85	84	85	81	82	81	79	82
Mechanical	Male	91	90	88	87	87	97	86	88
	Female	86	86	86	85	85	84	81	85
Textile	Male	96	95	94	94	94	92	90	94
	Female	93	92	91	89	87	84	79	88
Chemical	Male	87	88	89	86	83	84	84	86
Total average	Male	92	91	90	88	88	87	86	86
	Female	88	87	87	85	84	83	79	85

It will be noted that the average total attendance rates for men dropped from 92 percent in 1936 to 86 percent in 1942, whereas the attendance rates for women dropped from 87 to 81 percent during the same period. The average daily hours of work in three plants during this time were 11 for men and 10 for women. The physicians who made this study had no tabulated data later than 1942, but they stated that in 1943–44 the attendance rate for men dropped to about 80 percent, and for women to about 70 percent. The rate of attendance steadily decreased and by 1945 was about 50 percent in those factories located where the air raids were heavy. In the larger and newer factories where dormitories were provided, the attendance rate was higher, estimated at 70 percent, because food and transportation were not time-consuming problems. In the factories owned by the military forces, not shown here, the attendance was held close to 90 percent as barracks were provided and control of the workers was much more rigid. The absenteeism rates indicated by the attendance figures presented are probably never attributable to sickness in more than half the cases, as all the other factors caused by the war and the bombing played a very important part in absenteeism. The report showed, however, a steady decrease in body weight, especially in workers over 30 years of age, and a gradual increase in tuberculosis after 1939. Diseases of the digestive system and beriberi were highest in 1936, and gradually decreased afterwards until 1942 due to dietary factors.

The employment of children and young adults played an important part in the health conditions described above. In the metal factories, workers under 20 years of age increased from 35 percent in 1936 to 44 percent in 1942, which was typical of all factories. Since 1942, the size of the under-15 age group increased to 20 percent with the addition of 50,000 to 60,000 children in those factories, while the armed forces were drawing heavily on the 15–20-year age group. The children worked 5 days a week at first, 8 to 10 hours daily, and had a weekly holiday and a day of school. In the spring of 1944, the day of school was eliminated and the children worked 6 days a week. Near the war's end, there was a sharp increase in absenteeism, largely because of illness. It was observed that the children from schools with higher academic and physical entrance requirements had better attendance records than others.

Information on absenteeism up to 15 August 1945 was obtained from a large army arsenal consisting of eight factories, four in Tokyo, and one each in Kawagoe, Omiya, Sendai and Kosugi, and is shown in Table 98.

TABLE 98.—*Hours of work and absenteeism in army arsenal*

Year	Number of workers	Average hours per day	Average days per month	Percent of absenteeism
1931	5,000	10	24	2
1932	5,000	10	24	2
1933	4,900	10	24	2
1934	5,100	10	24	2
1935	5,000	10	24	2
1936	4,800	10	24	2
1937	13,835	11	27	(1)
1938	23,124	12	29	(1)
1939	32,506	12	29	(1)
1940	33,701	12	29	(1)
1941	36,880	12	29	11
1942	38,851	12	29	10
1943	38,500	11½	29	9
1944	47,807	11	28	7
Aug. 15, 1945	48,894	11	28	13

[1] Data missing.

It will be noted that the number of employees increased from about 5,000 in 1936 to almost 49,000 in 1945. The daily hours of work increased from 10 in 1936 to 11 in 1937; reached a level of 12 in 1938–42; were reduced to 11½ in 1943, and finally to 11 in 1944–45. Meanwhile the monthly days of work rose from 24 in 1936 to 29 in 1938–43, and were reduced to 28 in 1944–45. Although the proportion of sickness absenteeism to all absenteeism is not known, the personnel director of this arsenal stated that the hours of work had been reduced to 11 and the days per month to 28 because of increased fatigue, due to lack of sleep and long hours of travel, and increasing tuberculosis.

Even though the hours of work were decreased slightly and more dormitories were provided and despite the close and increasing supervision of employees, the rate of absenteeism had gradually increased from 2 percent for the years 1931–36 to 13 percent in 1945. By vigorous efforts the authorities had been able to reduce the rates from a previous peak of 11 in 1941 to 10, 9, and 7 in the years 1942–44, but the rates almost doubled over 1944 to 13 for the first seven and one-half months of 1945, rising from 10 percent in March to 30 percent in August. It was also reported that time lost owing to air raids and alerts varied from 10 percent in March to 40 percent in August. In these factories men were assigned to the air-raid details while the women usually remained at work. The proportion of females employees had gradually increased in these factories throughout the war, reaching 32 percent in 1944.

The rate of labor turn-over remained at a fairly low level in these factories, and even was markedly reduced during the last 4 years by stringent military control.

Similar data on absenteeism are not available from the navy-owned establishments, but it is known the number of civilian employees gradually rose from 49,000 in 1941 to 850,000 in 1945. The daily hours of work were increased from 10¼ in 1931–36 to 11¼ in 1937–41, and again to 12¼ in 1942–45, while the working days per month were increased from 25 to 26 and then to 28 at the same times. Meanwhile, the average daily wages for unskilled males had decreased from 1.88 Yen to 1.60 Yen and for females from 1.15 Yen to 1.00 Yen despite a decrease in the purchasing power of the Yen. The issue of food and some articles of clothing to many of the workers helped to offset these extremely low wages.

Additional statistics compiled by the Manpower Division on absenteeism in eight electric factories in the Tokyo-Yokohama area show a rapid rise during the war which was sharply increased where the plant areas were bombed. By the end of 1942, absenteeism at these plants ranged from 5 to 20 percent, by the end of 1943 from 10 to 30 percent, and by the end of 1944 from 12 to 35 percent. The majority of plants, by the summer of 1945, had absenteeism rates between 20 to 30 percent and several showed rates of 50 to 65 percent.

Special attempts were made to obtain information on the effects of the air raids upon industrial health and efficiency from Dr. Teruoka, Director of the Institute for Science of Labor, who was regarded as the leading authority in Japan on industrial hygiene and labor problems. Although he had no very recent statistics on industrial illness, he stated that the working ability of the factory employees decreased correspondingly. The attendance rates, which reflected the health status of workers, became low after the air raids, especially among the unskilled workers who constituted a very large majority late in the war. As the food supplies became smaller, the productive power of the workers decreased more rapidly that the sickness rates increased. It appeared that the effects of malnutrition upon production were greater in reducing general efficiency than in causing actual illness.

In addition to the lack of food, Dr. Teruoka stated that long hours of work, interruptions of work, the lack of sleep and recreation, difficulties in shopping for all necessities, anxiety, and the extreme irregularities and confusion of their daily lives, all contributed in producing a severe degree of physical and mental fatigue that drastically reduced the working capacity of the people. During and after the last bombing period, the major additional factor was the psychological effects from the confusion and the realization of the severity and probable outcome of the war. The air raids produced no special illnesses themselves but multiplied those that already existed and created a high degree of "nervousness" and there was a marked reduction in working capacity. As he put it, "there was so much to do that they could not do."

During the last months of the war, the long hours of work were not always as important in producing fatigue and illness as the other factors described. Following the air raids from Saipan beginning in September 1944, and especially after November 1944, the effects upon the supplies and transportation of materials were so serious that in many factories the workers were not kept busy and had much idle time during which they could rest or sleep.

During the war, there was a progressive deterioration in the health supervision and med-

ical care of factory employees because of limitations of medical personnel, shortages of supplies and equipment, and the greatly increased amount of medical work. The large numbers of casualties and the confusion caused by air raids greatly increased this problem, and in many factories there resulted a complete breakdown in medical services. This situation also contributed materially to the increasing illnesses and inefficiency among industrial workers.

OCCUPATIONAL DISEASES

Occupational diseases were not reported regularly to health officials by many factories because of wartime restrictions on the gathering of statistics and the secret nature of many operations. According to Ministry of Health officials, the actual bombardment of industrial plants had no significant effects upon the occupational disease problem. Indeed, the destruction of whole industrial plants eliminated this problem, and the marked slowing down of operations in other plants either by the direct or indirect effects of bombardment often mitigated the conditions which were producing occupational diseases.

The threat of air raids, however, kept many plants in industrial centers under black-out conditions at night which interfered seriously with the ventilation of operations that produced heat, gas and smoke. Although, during the latter part of the war, all factories concerned were experimenting with ways of solving this problem, no generally satisfactory method had been found for adequate ventilation under black-out conditions. It is believed that the majority of cases of heatstroke and carbon monoxide poisoning were the result of inefficient black-out procedures. This was a major problem in many of the steel mills and foundries and seriously interfered with production efficiency, according to Ministry of Health officials.

The tetraethyl lead plant built in 1942 in Koriyama was cited as an example of the effects of bombardment upon a plant with a serious health problem. The Japanese industrialists, with their usual disregard for human life, built the plant for producing this lead compound, a necessary additive to gasoline, without the inclusion of the necessary control measures to prevent wholesale poisoning of workers. When production was begun, about 40 percent of the employees became seriously ill and about 15 workers died. After the first few deaths, the majority of workers failed to appear for work for 2 weeks. This brought the problem to a head, and prompt assistance was requested from the Institute of Public Health, whose physicians put into effect the control measures developed in the United States more than 20 years previously. These included prevention of leaks, local exhaust ventilation, gas masks, special protective clothing, bathing and periodic medical examinations. Before the end of the war, the employment reached almost 7,000 workers with but few cases of lead poisoning. When this plant was destroyed by air raids, no one was poisoned although 200 workers were killed by the bombing.

When the question was raised as to how these workers accomplished a strike under conditions of wartime regimentation, it was explained that the government had only succeeded in gaining strict control of the war workers during the last two or three years of the war, but even then it was difficult to prevent them from alleging illness and staying off the job. A similar situation with regard to alleged illness existed in Germany, according to the Survey medical report, and is known to have been a matter of concern in many factories in the United States.

Other instances where occupational diseases were a serious production problem were said to have been rather few. There were many cases of dermatitis in munitions plants engaged in the manufacture of explosives including trinitroanisol, picric acid, and TNT, and as many as 50 percent of the new workers were so affected. Because workers rapidly became hardened or less susceptible to these compounds and the cases recovered in two or three weeks, this prevalence of dermatitis was not considered a major problem. The preventive medical program in these plants included powder uniforms, protective ointments, daily bathing, respirators, and preemployment and periodic medical examinations. The use of respirators was not satisfactory as the workers became careless after they became hardened and used them infrequently. Inasmuch as relatively little TNT was made in Japan and the other explosives produced were far less toxic than TNT, systemic or generalized poisoning from explosives

was not the problem there that it was in ordnance plants in the United States.

Some of the factories manufacturing basic chemicals for explosives experienced considerable difficulty because of their properties. Table 99 and 100 taken from a report of an investigation of munitions factories by the Institute for Science of Labor, show the prevalence of occupational diseases before and during the war in a large dyestuffs factory which was converted to explosives manufacture at the beginning of the war. It may be noted that the frequency of cases during the war (274 in two years) was somewhat less than before the war (439 in two years and eight months) although the number of workers exposed to these chemicals are not known. Of the 274 cases treated during 1943–44, dermatitis accounted for 248, while secondary anemia accounted for most of the others.

TABLE 99.—*Industrial poisoning in a dyestuffs factory*

[From January 1936 to September 1938]

Causes	Number of cases
Nitro and nitrochlorine compounds of benzene	224
Amido compounds of benzene	50
Other simple devivatives of benzene	24
Gases (CO, CO_2, Cl_2, H_2S, S, SO_2)	42
Solid materials (As_2O_3, $NaNO_2$, cement)	17
Bases and esters of organic and inorganic acids	39
Others	43
Total	439

[1] Table submitted by Japanese.

TABLE 100.—*Industrial poisoning in an explosives factory* [1]

[In 1942 and 1943]

Causes	Number of cases
Nitro-chloric compounds of benzene	250
Cyanic acid	10
Aniline	3
Chlorine gas	3
Carbon monoxide	2
Benzene	2
Chloric benzene	1
Sulphuric acid	1
Coal gas	1
SO_2 gas	1
Total	274

[1] Table submitted by Japanese.

This same report, as shown in Table 101 presents as described by the Japanese physician, the symptoms of 113 workers who were examined during the 1944 investigation of this explosives plant. Although the symptoms are listed as subjective, apparently some of them were determined by observation. It may be noted that a large proportion of the 87 aniline-exposed workers complained of headache, fatigue, cyanosis or pallor, dizziness, anorexia and discolored urine. The 12 workers exposed to nitrobenzene had similar symptoms. Of the 30 workers exposed to dinitrochlorobenzene, 20 had some degree of dermatitis, 8 were losing weight, and a few had other symptoms. Only four workers with nitronaphthalene exposure were examined, but three of those complained of headache, fatigue, cyanosis or pallor, and discolored urine.

A study of the plant operation revealed that the sources of the toxic exposures were small leaks in the chemical equipment which were caused by maintenance difficulties and the improper training of employees. Previously, it had been customary to close the plant for a month in summer for repairs to equipment and as a vacation for employees, but this had not been done for two years. In addition to correcting all sources of exposure as much as possible,

TABLE 101.—*Subjective symptoms of workers in an explosives plant in 1944* [1]

	Aniline workers	Nitro and dinitro-benzene workers	Dinitro-chloric benzene workers	Nitro-naphthalene workers
Number of workers examined	67	12	30	4
Local symptoms:				
Eruption and inflamation of skin	1	0	20	0
Cough or sputum	2	0	4	0
Hyperemia of conjunctiva	0	0	2	0
General symptoms:				
Headache and heavy feeling in the head	53	9	4	3
Weariness and unwell	28	7	4	3
Becoming thin	7	3	8	1
Coma or unconsciousness	4	0	0	0
Others	6	1	1	1
Circulatory symptoms:				
Cyanosis or pale	53	9	2	3
Dizziness	37	3	1	0
Dyspnea	9	1	4	0
Palpitation	7	9	5	11
Digestive symptoms:				
Nausea and vomiting	6	0	0	0
Anorexia	12	3	2	0
Others	3	0	2	1
Sensitive symptoms:				
Strange feelings in mouth	4	0	0	0
Others	1	1	0	0
Abnormal colouring of the urine	16	2	0	3

[1] Table submitted by Japanese.

recommendations were made to provide protective clothing and bathing facilities, and to arrange a system of transferring workers so that after one week of exposure each employee would be shifted to another job for four weeks. These recommendations were followed and the

TABLE 102.—*Reported cases of occupational diseases in 1944 (from 34 out of 47 prefectures)*[1]

Name of occupational diseases	Number of factories	Number of workers in those factories	Number of workers working in hazardous workplaces	Number of patients in 1944
Mercury poisoning	4	4,445	729	249
Arsenic poisoning	3	----------	409	28
Phosphorous poisoning	2	1,423	133	22
Phosphoric-hydrogen poisoning	2	2,882	70	10
Chromium poisoning	9	----------	128	87
Manganese poisoning	2	1,807	98	19
Zinc poisoning	1	953	100	5
Chlorine poisoning	16	45,735	1,425	197
Fluoric-hydrogen poisoning	5	2,084	400	131
Nitrogen poisoning	12	----------	250	38
Chloric Acid poisoning	12	----------	370	90
Sulphuric Acid poisoning	21	----------	878	227
Sulphuryl (SO_2) poisoning	5	3,555	390	43
Ammonia poisoning	4	17,226	360	13
Carbon-monoxide poisoning	17	----------	1,927	366
Carbon-disulphide poisoning	2	15,108	57	28
Formalin poisoning	1	178	30	66
Titanium tetrachloride poisoning	1	465	15	36
Ethylene trichloride poisoning	1	29,474	288	8
Benzol poisoning	14	----------	860	158
Nitrobenzol and aniline poisoning	11	36,358	2,519	291
Dermatosis due to kerosene	7	3,897	751	53
Paraffine itch	2	1,105	44	6
Dermatosis due to mineral oil	4	3,325	334	36
Dermatosis due to caustic alkali	5	5,496	625	37
Dermatosis due to alumina-clinker	2	1,446	265	74
Dermatosis due to chlorinated naphthalene	4	2,003	216	186
Dermatosis due to lacquer	9	4,695	176	126
Conjunctivitis due to strong light	78	----------	7,590	2,543
Dermatosis due to wet work (spinning)	55	----------	10,519	1,544
Heatstroke	56	----------	6,093	930
Dermatosis due to tar or pitch	14	----------	1,979	601
Diseases due to noisy work	18	80,498	13,659	429
Diseases due to dust	22	----------	4,036	337
Sulphuric-hydrogen poisoning	9	29,999	2,808	488
Total	430	294,157	60,531	9,502

[1] Tables submitted by Japanese.

situation was largely corrected. The anemia which was present in the majority of these workers was relieved in about four weeks with the aid of multi-vitamin and iron preparations. The dermatitis cases recovered readily upon removal from exposure. The investigators reported that here as elsewhere they found the use of vitamin C very helpful for the prevention and treatment of industrial poisoning. They stated that vitamin C deficiency had been observed generally in such cases by a decolorization skin test and that this vitamin is of importance in assisting the "detoxifying action of the adrenal glands."

The most recent data for obtaining a general picture of the occupational disease problem in Japan are presented in Table 102 which shows the number of occupational disease cases reported by causes, the number of workers exposed, the number employed, and the number of factories involved for 34 out of 47 prefectures for 1944. It may be noted that conjunctivitis (due to strong light), dermatitis due to wet work (spinning), heatstroke, tar dermatitis, hydrogen sulfide poisoning, "disease due to noisy work," carbon monoxide poisoning, and dust-produced diseases lead the list in order of frequency and each accounts for more than 300 cases. Other occupational diseases frequently reported were nitrobenzol and aniline poisoning, mercury poisoning and sulfuric acid poisoning. Dermatitis from all causes accounted for 2,653 or 28 percent of the 9,442 cases of occupational disease here reported.

The Ministry of Health officials also had information regarding the occurrence of occupational diseases of sufficient importance to come to their attention during the last year or two. In the airplane factories there had been a small number of cases of trichlorothylene poisoning at degreasing operations, and many cases of dermatitis from diphenylazobenzol used in making sponge rubber for gasoline tanks. These latter cases suffered considerable discomfort which resulted in some absenteeism. In the manufacture of aniline, several plants with rather primitive equipment had a fair number of cases of aniline poisoning whereas modern plants experienced little difficulty. There were also cases of headache and other symptoms from exposure to ethylene chlorohydrin while making insulation. Before the war, there had been about 50 rayon factories which had had considerable difficulty with carbon-disulphide poisoning but this problem had been controlled and all but five of these factories had since been converted to war industries. The storage battery factories had occasional cases of lead poisoning but it was stated these were not serious in number or degree.

Silicosis, a serious problem in many American trades, was important in relatively few Japanese industries, notably in the Ashio copper mines near Tokyo, a few of the pottery factories, and to a lesser extent in some of the foundries. Very little had been done to control this disease except for the use of wet drilling in the mines and the physical examinations required by law, as it was stated the owners were "old-fashioned and indifferent." At the smelters, there had been serious cases of arsenic poisoning which were later controlled by the use of electrostatic precipitators.

TABLE 103.—*Industrial accidents for all japan, 1937–42*

Year	Deaths		Severely injured [1]		Slightly injured [2]		Total	
	Actual number	Rate per 1,000 workers	Actual number	Rate per 1,000 workers	Actual number	Rate per 1,000 workers	Actual number	Rate per 1,000 workers
1937	681	0.248	23,137	8.41	77,680	28.24	101,498	36.90
1938	834	.275	26,541	8.74	90,869	29.92	118,244	38.94
1939	888	.250	28,628	8.07	91,467	25.79	120,983	34.11
1940	840	.229	30,002	8.17	97,042	26.47	127,884	34.87
1941	880	.232	29,960	7.91	103,549	27.32	134,389	35.46
1942	885	.250	21,495	7.83	124,441	30.92	146,821	39.00

[1] Absenteeism over 14 days.
[2] Absenteeism over 3 days to 13 days.

It was learned, from interrogation of key officials in the Ministry of Health and Social Affairs and in several prefectural departments, that very little attention had been given to the control of factory health hazards by standard engineering practices commonly recognized as essential in the United States and other Western nations. Indeed, trained industrial hygiene engineers were almost nonexistent in Japan. The detection and control of health hazards were the functions of the prefectural physicians both in the health and labor sections. They made infrequent inspections of factories and were available for consultation on health problems. The limitation of personnel in these departments during the war and the lack of close cooperation between these departments resulted in an ineffective health program generally. The larger factories with one or more full-time physicians had considerable better experience in determining and controlling unsafe working conditions than the many factories having no physician. In the small shops and household industries, working conditions were often very unsatisfactory.

Health officials stated repeatedly that most factory owners were too unprogressive and indifferent to show any active concern for the health protection of their employees. As a result, many factories had made no attempts to control health hazards and many others had done only what seemed absolutely necessary. Inspections of representative shipyards, machine shops, ordnance plants, and airplane, light bulb, and storage battery factories confirmed these statements.

INDUSTRIAL INJURIES

Prewar industrial safety activities generally were limited in Japan, and even these were curtailed during the war. An industrial safety week was held in early July each year, at which time the government distributed propaganda in a program that included lectures, movies, pamphlets and posters. An industrial safety conference had been held annually until 1943 when it was prohibited because it involved up to 3,000 factory and government officials. There were no large safety organizations except the administrative activities of the central government in the Bureau for Labor in the Ministry of Health and Social Affairs, and certain accident prevention activities in the Institute of Public Health.

Although no recent accident statistics were available to show the general trend in Japan, officials were agreed that, excepting certain plants where safety was stressed, the accidental injury rates rose year by year during the war. Table 103 shows the annual number and degree of industrial injuries for all Japan for the years 1937 through 1942. As this table excludes injured cases losing less than three days' time, these rates cannot be compared with standard United States frequency rates. It may be noted that the total injury rate declined to 34.11 per 1,000 workers in 1939 and rose to a peak of 38.96 in 1942, and that the slightly injured workers (off 3 to 13 days) accounted for this rise. Table 104, with the industrial breakdown of the number of industrial accidents, shows that the mechanical industries and metal industries accounted for the great majority of these injuries in 1942 with almost 89,000 and 46,000 injuries, respectively.

Table 105 summarizes the wartime accidental injury experience for one large mechanical industry plant and two large steel plants which, according to the Japanese, had active safety programs. Plant C is the only one for which all

TABLE 104.—*Actual number of industrial accidents in 1942*

	Deaths	Severely injured	Slightly injured	Total
Metal industry	320	11,125	34,350	45,795
Mechanical industry	341	14,061	74,514	88,916
Chemical industry	99	2,785	8,824	11,708
Gas, electric and water supply works	21	240	541	802
Pottery industry	20	1,537	1,612	2,169
Textile industry	20	1,048	2,079	3,147
Timber industry	56	1,138	1,641	2,835
Foodstuffs industry	8	243	540	792
Printing and bookbinding industry	----------	31	77	108
Others	----------	114	262	376
Total	885	32,322	124,440	156,648

TABLE 105.—*Industrial accidents in several plants*

	Number of workers (estimated)	Rate per 1,000 workers			
		Deaths	severely injured	Slightly injured	Total
Plant A [1]:					
1942	15,000	0.27	12.0	22.4	34.67
1943	16,000	.13	12.1	21.0	33.23
1944	17,000	.06	21.1	24.7	45.86
Plant B [2] (Actual):					
1939	----------	----------	36.0	163.5	199.4
1940	----------	----------	31.5	96.0	127.5
1941	2,547	.4	29.4	39.3	69.1
1942	3,185	----------	31.7	22.6	54.3
1943	3,493	1.5	36.4	26.6	64.5
1944	3,578	1.4	38.8	13.4	53.6
Plant C [3]:					
1939	5,621	3.2	75	86	164.2
1940	7,258	1.8	64	76	141.8
1941	7,900	1.3	48	58	107.3
1942	8,701	.6	40	60	100.6
1943	8,735	1.6	31	46	78.6
1944	10,161	2.0	49	75	126.0

[1] The Hitachi plant, Hitachi Manufacturing Co. (mechanical industry)
[2] The Yasugi plant, Hitachi Manufacturing Co. (steel industry).
[3] The Kamaishi plant, Nippon Steel Co. (steel industry).
In the slightly injured cases of Plant C are also included cases which showed absenteeism less than three days.

lost-time injuries are shown, i.e., including those of one to three days' absence in the slightly injured group. For Plants A and C the interpretation of the varied rates was that the accident prevention program resulted in decreasing the injury rates during 1942 and 1943, but the increasing severity of the war resulted in a large increase in the rates in 1944 (from 33 to 46 and from 79 to 126, respectively). In Plant B, however, special training of new workers by lectures, pamphlets and a model workers' system was thought to be very effective, as indicated by the marked reduction in the rates for slightly injured cases, which commonly occurred among new and untrained workers. Despite this, severe injuries, which usually occurred among skilled workers, increased during 1943 and 1944.

United States accident frequency rates are based upon the number of lost-time injuries per million man-hours of work. If the total rates for Plant C where all lost-time injuries were supposed to have been reported are converted to lost-time injuries per million man-hours, the frequency rates for the 6 years beginning with 1939 were approximately 46, 39, 30, 28, 22 and 35. The frequency rates for American industries employing 90 percent of American workers engaged in the production of iron and steel for the same years beginning with 1939 were 9, 9, 10, 10, 10 and 9.[1] The Japanese rate of 35 lost-time injuries per million man-hours in 1944 is four times that of comparable American industry for the same year, and represents a great loss of manpower and efficiency.

The accident rates were significantly higher in 1945 because of the increasing fatigue and confusion resulting from the air raids. However, no data were available to show the extent of the increase except the over-all increase in absenteeism described previously. Visits to representative munitions factories, shipyards, aircraft plants and electrical equipment plants indicated a serious lack of the safeguarding of machines, good housekeeping, lighting and other factors which are basic principles in industrial safety. Even some of the larger air-raid shelters observed were so crowded with machinery, debris and materials, that speedy ingress would be hazardous. From all available information it appeared that the safety program was ineffective and deteriorated with the increasing pressure of wartime conditions. The air raids aggravated the problem considerably, but to what extent is not known. It was stated on several occasions that traffic accidents were a serious problem during and after the air raids.

SPECIAL HEALTH PROBLEMS

The health of many Japanese working-class people was impaired enough to create a real problem to those physicians in the more modern industrial establishments who were trying to employ only physically fit workers and to prevent infectious disease cases from entering the plants. Even before the war this was a problem wherever careful physical examinations were made of applicants for work. For example, in the Nakajima aircraft factories in 13 prefectures, a report shows that from September 1937

[1] Data obtained from Max D. Kossoris, U. S. Bureau of Labor Statistics.

through May 1939, 31.4 percent of all applicants for work were rejected by the examining physicians. Of those examined, 5.1 percent had active tuberculosis, 7.4 percent were suspected of having tuberculosis, 14.8 percent had other physical disabilities, and 4.1 percent were rejected for "other reasons," presumably physical or mental conditions. The percentage of those applicants disqualified for work in different employment categories is shown in Table 106.

TABLE 106.—*Applicants for work disqualified for physical Disabilities, Nakajima Aircraft Factories*

	Percent
Skilled men	24.7
Apprentices	39.9
Middle-aged men	25.5
High School graduates	32.0
Women and Children	37.3

The fact that 12.5 percent of all these applicants either had active tuberculosis or showed some evidence of inactive or latent tuberculosis is an index to the seriousness of this problem in Japan. In addition, the preemployment tuberculin test which when positive indicates present or past tuberculous infection, gave a positive reaction in 24.7 percent of these applicants, ranging from 16.8 percent in Ibaraki prefecture to 65.0 percent in Tokyo prefecture. Unlike many other industries, the prevalence of tuberculosis was reported to have been kept at a minimum in these factories during the war by the exclusion of active cases and the use of BCG vaccine in susceptible persons.[2] Before the air raids, the medical staff had been able to maintain fairly good control over the health of the workers, but afterwards the resulting confusion made it difficult to follow established procedures of control and it was not certain to what extent their health had been affected. It was stated that the long hours of work and lack of food caused sufficient exhaustion to increase absenteeism, even though these workers were under rigid police control.

At the Yuassa Battery Co., near Osaka, tuberculosis and malnutrition were considered to be the most serious health problems. The medical staff, considered the best in the prefecture, stated that about 5 percent of job applicants were found to have tuberculosis, and about 1 percent of the previously screened employees developed tuberculosis annually. Some individuals with tuberculosis were employed during the war because of the labor shortage. The medical director stated the main problem was malnutrition which lowered the workers' resistance to the point that they did not recover from common infections in a normal manner. The average daily diet was 1,800 calories but the workers here received 200 to 300 extra calories from additional rice. Despite the large number of lead-handling operations there had been few cases of lead colic, a fact which he attributed to the periodic physical examinations to detect early symptoms.

The dispensary at the Tokyo-Shibaura Electrical Co. in Tokyo was located in the administration building after the April and August air raids destroyed the plant hospital. This plant engaged in the manufacture of radio and radar tubes and light bulbs, had formerly employed 15,000 workers but was now reduced to 3,000 because of the destruction of several major units. Tuberculin tests and X-ray films were also utilized here to eliminate applicants with tuberculosis, and for the annual examinations. The plant medical records had been destroyed by the April air raids but the following 639 cases of illness were treated in the out-patient clinic between 23 April 1945 and 31 July 1945:

TABLE 107.—*Number of cases of illness among outpatients, Tokyo-Shibaura Electrical Co. clinic (April–July 1945)*

Gastro-intestinal disorders	230
Colds and acute bronchitis	192
Pulmonary tuberculosis	115
Pleurisy	64
Beriberi	32
Rheumatism	3
Infectious jaundice	3

It may be noted that tuberculosis and its common manifestation, pleurisy, accounted for 28 percent of all illnesses during the last months of the war, while beriberi and gastro-intestinal disorders, the latter often a symptom of malnutrition, accounted for 41 percent. The incidence of upper respiratory infections was not remarkable. Unfortunately, there were no available data on absenteeism.

In the large Mitsubishi shipyards in Kyushu the number of employees had been reduced from a wartime high of 21,000 to a low of 7,500 in

[2] Public Health Report, 7 June 1946, indicates recent favorable United States experience with this vaccine.

November 1945, although at this time almost 2,000 were absent daily, largely because of local transportation difficulties. All new employees had undergone the usual preemployment examinations and about five percent of these had tuberculosis. Wartime conditions of work had resulted in increased malnutrition, especially beriberi, tuberculosis, dysentery and many cases of scabies and other skin diseases. The annual examinations had revealed about 15 percent of new cases of active tuberculosis. The medical director stated that dysentery had become more prevalent since the air raids.

An extensive investigation of the health of factory laborers from 1936 through 1942 was made by Dr. Tomoyoshi Ishikawa and his assistants in the Industrial Hygiene Section of the Institute of Public Health. This investigation of 120 privately owned factories each employing 1,000 or more workers was made in connection with employees' National Health Insurance and included such factors as body weight, beriberi, diseases of the digestive system, tuberculosis, absenteeism, hours of work, and age distribution.

It was found that the body weight decreased from year to year, especially in males, and that the rate of decrease was higher in men over 30 years of age than in younger age groups. The average body weight for all males in all factories declined from 53.2 kilograms in 1936 to 50.3 kilograms in 1942, a difference of 2.9 kilograms or almost 6.5 pounds. The average decline in weight by industries was 3.7 kilograms for foundries, 1.2 kilograms for metals industry, and 2.9 kilograms for mechanical industries. The weight decline in chemical plants was not significant. The average weight for female employees declined from 47.5 to 45.6 kilograms, a loss of 1.9 kilograms or 4.25 pounds in the mechanical industries, but showed no major variation in the metals industry. (Chapter on Nutrition).

Data showing the prevalence of beriberi sufficiently severe to cause three or more days' absence from work was obtained from the health insurance department. From a peak monthly rate of 27 per 1,000 males in October 1936, the incidence of beriberi decreased rapidly to 14 per 1,000 in August 1941, but began to rise again in 1942 and reached a new seasonal high level of 28 per 1,000 in July 1942. The highest rates were in the metals and mechanical industries while the lowest were in the chemical plants. The investigators stated they did not believe there was a major increase in beriberi rates among industrial workers after 1942 because less rice was available than formerly. Recourse was made to other foods and many industries provided workers with vitamin concentrates. It was stated that because of these factors, the edema of beriberi was seldom observed, but investigators could find the early stages with sensory disturbances and muscular weakness.

Diseases of the digestive system were quite common throughout this period with a seasonal rise during the summer months. The high and low monthly morbidity rates per 1,000 male and female workers are shown in Table 108:

TABLE 108.—*Incidence of diseases of the digestive system among factory workers, 1936–42.*

[Per 1,000 workers]

	1936	1937	1938	1939	1940	1941	1942
Males							
High	79	60	58	48	43	34	45
Low	22	24	23	22	19	15	20
Females							
High	31	28	28	23	18	16	13
Low	7	8	6	5	6	4	5

A well-marked decline in the frequency of these disorders is observed for the years 1936–41, but in 1942 the summer rates increased sharply among the male workers. It was stated that with reduced food supplies in 1943, 1944 and 1945, the prevalence of digestive disorders became more serious.

This investigation showed that the incidence of illness attributed to tuberculosis among these factory workers gradually increased, especially after 1940 through 1941, with a sharp rise in 1942. The following figures show the highest monthly tuberculosis morbidity rates per 1,000 male and female factory workers for the years 1936–42:

	1936	1937	1938	1939	1940	1941	1942
Males	4.5	5.0	5.6	5.8	8.2	10.8	18.4
Females	9.2	9.0	9.2	8.2	9.2	10.0	21.0

The 1936 incidence of tuberculosis among males had doubled by 1941 and quadrupled in 1942,

while among females it remained fairly constant until 1942 when it reached a peak rate double that of any preceding year. Tuberculosis was much more prevalent among females until 1941 when the rapid increase among the males caused the male rates to become higher. This early preponderance of tuberculosis among females was true only in the mechanical industry. Tuberculosis was more prevalent among males in the metals industry and the rates in the chemical industry were approximately the same. In classifying the plants by districts it was noted that the prevalence of tuberculosis increased more markedly in the Kinki and Kyushu districts than in the others. These investigators emphasized that according to information from factory physicians and factory inspectors the prevalence of tuberculosis had increased rapidly since 1942 when these data were collected. Two important causes for this rise were the continued lack of sufficient food to maintain health and the deterioration of factory medical services and health supervision to the point where cases of active tuberculosis were not found and isolated. The labor shortage also contributed to the employment of workers with tuberculosis and other diseases ordinarily considered disqualifying, and many workers were not even examined.

The absenteeism figures gathered in this investigation have been presented in a previous section. However, a special correlation made in one iron and steel works, between the hours of work and absenteeism showed that as the average daily hours of work were raised from 9.9 in 1936 to 11.0 in 1942, the attendance rate fell from an average of 86.7 percent to 78.2 percent.

Because of the gravity of the tuberculosis problem in industry, and the deterioration of health services, the Institute for Science of Labor made a special survey in 1943 in representative factories. The results of this survey are shown in Table 109.

It may be noted that the prevalence of active tuberculosis was found to be quite high in many of these industries. These high rates compared very unfavorably with United States industries in which X-ray surveys of 1,000,000 adult war

TABLE 109.—*Prevalence of active tuberculosis among factory workers, 1943*

Location	Active tuberculosis, open and closed (percent)	Open tuberculosis only (percent)
Osaka prefecture:		
Metal factories	3.9	[1]
Mechanical factories	5.9	[1]
Chemical factories	5.6	2.3
Tokyo prefecture:		
Mechanical factories	6.5	2.0
Printing factories	10.7	4.4
Chemical factories	3.9	1.3
Shizuoka prefecture:		
Rayon factories	1.9	.6
Kyushu:		
Coal mines	3.0	1.0
Tohoku:		
Metal mines	3.7	1.8

[1] Indicates data not available.
[2] This report showed about 1.5 percent with adult type of pulmonary tuberculosis but it was ascertained from the authors that only one in three was subsequently determined to have active infection.

workers indicated about 0.5 percent [3] had evidence of active tuberculosis. Of more importance in controlling the spread of infection are the open or infectious cases, ranging from 0.6 to 4.4 percent of these workers, who are a constant source of danger to other employees. The physicians who made this 1943 study believed that tuberculosis had increased markedly since that time because of malnutrition, and that the loss of control of and dispersal of infectious cases caused by the air raids further aggravated this problem.

Other data showing the gravity of the tuberculosis problem in Japanese factories are presented in Table 110. These data resulted from investigations in Osaka prefecture by the health department, the Japanese Anti-tuberculosis Society, and the annual examinations required for males 15 to 26 years of age and females 15 to 20 years of age, by the "Law of the National Control of Physical Strength" passed in 1942. Other examination results included are the annual examinations made under the Factory Act which were reported to the prefectural government. In the large factories these were made by the factory physicians whereas in the small factories they were made by a part-time doctor or the prefectural physicians. On the mass surveys X-ray studies were made, at least on the positive reactors to the tuberculin test, al-

[3] This report showed about 1.5 percent with adult type of pulmonary tuberculosis but it was ascertained from the authors that only one in three was subsequently determined to have active infection.

TABLE 110.—*Results of tuberculosis surveys in industries in Osaka prefecture*

Year	Industry	Number examined	Percentage with tuberculosis			Total
			Inactive	Active—open	Active—closed	
1940	Cotton mills [2]	6,660	3 3	1.0	(1)	4.3
1940	Heavy industry [2]	9,138	5.3	2.2	(1)	7.5
1940	Fiber factories [3]	6,115	1.9	1.0	.8	3.7
1940	Heavy industry [3]	11,360	1.8	2.4	1.3	5.5
1941	Heavy industry [2]	4,618	5.6	3.3	(1)	8.9
1941	Fiber factories [3]	3,884	.8	.8	.5	2.1
1941	Heavy industry [3]	22,501	1.7	2.7	1.3	5.7
1941	Factories [4]	48,515				2.6
1942	Small factories [2]	5,037	9.6	4.4	(1)	14.0
1942	Heavy industry [3]	15,133	1.5	1.2	1.3	4.0
1942	Factories [4] (children)	90,128				5.3
1943	Miscellaneous factories [2]	1,124	4.7	1.3	(1)	6.0
1943	Miscellaneous factories [3]	26,121	1.0	1.1	.8	2.9
1943	Miscellaneous factories [4]	96,351				5.3
1944	Miscellaneous factories [4]	74,103	3.2	1.1	.8	5.1

[1] Where data are not shown in appropriate column, there was no distinction made between open and closed cases.
[2] Prefectural investigations.
[3] *Anti-Tuberculosis Society* investigations.
[4] By law for the national control of physical strength, young males only.

though the X-ray was not always included in the examinations in some small factories. The data are not strictly comparable by these varying techniques but it will be noted that the prevalence of tuberculosis was rather high in all these studies, the median rate being 5.3 percent. Data from factories were not available for 1945 because work was disorganized by the air raids. Among the 4,300 male high-school and college students examined early in 1945 there were 149 cases of tuberculosis, a rate of 3.5 percent as against 2.5 percent for similar groups in 1944, which substantiates the rising trend claimed by Japanese officials. The rates for factories would be higher for each year were it not for the required rejection of job applicants with active tuberculosis, and the cases detected by previous examinations and placed under treatment. Indeed, the sizeable number of cases found in these plants reflects, in part, the breakdown in the efficiency of medical services in these factories.

The prefectural health office in Osaka furnished data showing the results of physical examinations of young males, age 15–26 years. These were made according to the Law for the National Control of Physical Strength for the years 1941–44 and showed the prevalance of tuberculosis, beriberi, and trachoma. The prevalence of tuberculosis among those employed in industrial plants was shown along with other industrial tuberculosis surveys in Table 110. The complete data on illness revealed by these examinations are shown in Table 111. The examinations were made on 14,123 students, 309,097 factory employees, and 437,412 other young males in cities, towns and villages. This sample should be a fair cross section of young males in Osaka prefecture. In 1941 examinations were made only of males 15–19 years of age whereas in 1942–44 the examinations included males under 26 years of age. The rates for 1941, therefore, may not be strictly comparable to the rates for other years.

It may be noted that after 1941 tuberculosis was about twice as prevalent in the factories as in the schools. In 1942, it was approximately twice as prevalent in the factories as in the other groups in the cities, towns and villages, but a marked increase of rates in the latter groups in 1943–44 far outdistanced the factories. The average rates for all groups in the years 1942–44 remained about six percent, which indicated the seriousness of this problem.

TABLE 111.—*Results of 895,632 physical examinations of young males in Osaka prefecture*

	1941	1942	1943	1944
Tuberculosis (percent):				
Schools	1.86	3.09	3.20	2.10
Factories	2.63	5.33	5.28	5.16
Others	2.86	2.54	9.27	8.97
Weighted average	2.67	6.20	6.57	5.56
Beriberi (percent):				
Schools	.95	.67	.50	.39
Factories	4.39	2.87	2.09	1.54
Other	2.42	1.31	1.12	1.33
Weighted average	2.61	1.73	1.43	1.21
Trachoma (percent):				
Schools	1.78	1.53	1.30	1.18
Factories	6.27	5.25	4.18	3.81
Others	14.52	14.82	11.93	12.74
Weighted average	10.70	9.80	6.89	5.77

Evidence of beriberi was found in 2.61 percent of these examinations in 1942 but became somewhat less prevalent with rates of 1.73, 1.43 and 1.21 for the years 1942–44. The rates among factory workers were roughly twice as high as among the unemployed in cities, towns and villages, and were about four times the rates for students. These data support the opinion of health officials that the incidence of beriberi had declined during the war because of the lessened use of polished rice.

Here as elsewhere in Japan trachoma was a problem, but the data indicated its prevalence decreasing from an average rate of 10.7 per-

cent in 1941 to 5.77 percent in 1944, the greatest reduction being in the factory group. The prevalence of trachoma was almost four times as great in the factories as among students, but was only one-third to one-fourth as great as among the cities, towns and villages. No explanation was given for these differences in rates and trends, but previous reports indicated a decrease in trachoma because of an active preventive medical program. Examinations in 1923 revealed the incidence of trachoma to be 14.68 percent among conscripts, 10.84 percent among factory workers, and 16.69 percent among school children. By the end of 1938, there were 1,305 clinics for the exclusive treatment of trachoma.

Syphilis was an important problem among industrial workers as in the population generally, but was given very little attention. Routine blood tests or mass surveys were seldom made, and even the plants with large medical staffs seemed unconcerned about this disease. It was stated that so much concern and emphasis had been placed on the control of tuberculosis and malnutrition that little time was available for other health problems in industry. A random survey of 1,000 persons in Osaka city shortly before the war revealed 10 percent with positive blood reactions indicating syphilis. In this group municipal workers had a rate of five percent, therefore it was probable that the rate for the industrial workers included was somewhat higher than the average rate of 10 percent. In Kyoto, the prefectural health officials stated that in factories employing many young workers with fairly high wages, a wartime survey of 5,000 men showed 16 percent with positive syphilitic reactions. It was the consensus that rates for all venereal diseases had increased seriously during the war because of more young girls in the factories, increased earnings, and a weakening of morals. In Osaka, it was also stated that illegal abortions had been a serious problem.

Since 1943 almost all workers in factories have been protected by the National Health Insurance Law. Under this law, sick industrial workers are entitled to a cash allowance, free medical care, maternity benefits and a small sum for burial expenses. Physicians attending workers insured under this law were paid by the government through the medical society, and the selection of physicians was on a panel basis. Although data were not available for 1945, it is doubtful if they could have shown the complete picture of industrial illness, as, according to the Ministry of Health officials, there was a tendency late in the war for workers to go to private physicians rather than the doctors provided by the national insurance law, as many workers had more money than formerly.

SUMMARY

Bombardment in the target areas affected the health and hygiene problems of industrial workers chiefly by aggravating the existing illnesses, fatigue, and inefficiency caused by wartime conditions and the further deterioration of factory medical and health services.

Fatigue was an important cause of absenteeism before the air raids and became even more so afterwards. During the war, the usual workday for adults had been increased to 12 or more hours and for children to 10 hours. Adults were allowed one holiday every 2 to 4 weeks and children were permitted one holiday per week. Unlike the Western nations by 1943 the Japanese had relaxed many of the protective measures of their labor legislation, especially pertaining to women and children. One outstanding fact was the indifference of the industrialists toward the health and efficiency of their war workers.

With the progress of the war and especially after the air raids, food supplies became shorter, more time-consuming effort was required to obtain the meager rations allowed, and malnutrition became an important problem despite extra allotments to industrial workers. Local transportation difficulties increased workers' traveltime. The confusion resulting from the raids in target areas made every detail of daily living a difficult task, even in those areas where the workers' homes were still intact. The threat of air raids kept many factories under black-out conditions and, as ventilation was inadequate, the effects of heat, gases and smoke increased illness and decreased efficiency. The psychological factors associated with the confusion, frustration and anxiety caused by air raids appeared to be an important cause of increasing fatigue. The limited number of in-

dustrial physicians, with inadequate medical supplies and equipment, had their work greatly increased by the air raids. The result was a serious deterioration of health supervision.

All of these factors caused a state of chronic fatigue that along with actual illness contributed to the absenteeism which became an important factor in production. Studies of 120 representative factories showed that average attendance rates for males declined from 91 percent in 1936 to 86 percent in 1942, and for females from 87 percent to 81 percent during this interval. Estimates by industrial hygiene officials in the Ministry of Health indicated that during 1943–44 the attendance rates for men and women dropped to about 80 and 70 percent, respectively. After the 1945 air raids, the attendance rates for factory workers in the heavily industrialized target areas declined to about 50 percent where the bombing was heavy, and this factor became a major production difficulty. The attendance rates declined only to about 70 percent in the more modern factories where sufficient dormitories were provided to ease the transportation and food supply problems, and held close to 90 percent in army-owned factories where barracks were provided and strict military control was maintained. The factories in the mountains and small towns were able to maintain much better attendance than those in the target areas.

Another investigation by the Ministry of Health revealed that certified sickness absenteeism had doubled in 1942 and tripled by 1943 from the 1937 rates of 2.5 percent among males, and 2.8 percent for women. The rates in 1943 were 7.2 percent for males and 9.0 percent for females After 1943 it was the consensus that there was a progressive increase in illness rates. The chief industrial illnesses were tuberculosis, digestive disorders, colds, beriberi, pleurisy, bronchitis, conjunctivitis and neuralgia.

In one large army arsenal, where workers were under stringent military control and barracks were provided, absenteeism rates rose from an average of 7 percent for 1944 to 13 percent for the first 7½ months in 1945, and during this latter period the monthly rates rose from 10 percent in March to 30 percent in August.

Fatigue and malnutrition, major factors in causing increased illness and absenteeism, seriously impaired the efficiency of those workers able to remain on the job.

Tuberculosis, malnutrition and syphilis were major health problems among Japanese war workers. These problems were intensified by the air raids. Tuberculosis accounted for 28 percent of all illnesses during the last months of the war in one large factory, while gastrointestinal disorders and beriberi, which are common manifestations of malnutrition, together accounted for 41 percent of the illness there. Even before the air raids, a special survey of nine leading industries in five districts indicated that from 1.9 to 10.7 percent of the workers had active tuberculosis, the average rate being five percent. Of these cases from one-third to one-half were open or infectious cases and a danger to all contacts. The dispersal of cases and the crowding of families because of the air raids undoubtedly was resulting in an increase in the prevalence of tuberculosis.

It was generally agreed that malnutrition had increased, especially since the air raids. Beriberi rates, however, declined early in the war and, with few exceptions, did not become more prevalent during the latter part of the war.

Syphilis was an important though unrecognized problem. Although limited surveys indicated that 10 to 16 percent of factory workers had positive blood reactions, little concern was shown for this problem as all the emphasis was placed on tuberculosis and malnutrition.

Trachoma appeared to decline as it had in the pre-war years, although it was still an important problem. In one large industrial group the trachoma incidence had dropped from 10.7 percent in 1941 to 5.8 percent in 1944.

Dysentery was mentioned by several factory physicians as an important problem, but in general it appeared to parallel the trends in the various localities which are described in the chapter on communicable diseases.

Limited data on occupational diseases did not indicate these to be a major problem in most Japanese industries. Owing to the indifference of the industrialists and military officials, however, few or no standard control measures were utilized to prevent these diseases before they became unavoidable issues. Industrial hygiene engineering control of hazardous occupations was largely unknown outside of governmental health agencies, which had little authority over

war industries. Efforts to control occupational diseases were often made only by factory and prefectural physicians, who were badly overworked. Almost 10,000 cases of occupational diseases were shown by 34 prefectures in 1944. These diseases included dermatitis, conjunctivitis, heatstroke, deafness, pneumoconiosis and the usual variety of poisonings from toxic dusts, vapors and gases. The air raids relieved or solved the occupational disease problems in target areas by slowing down production or by destroying the factories.

Accident prevention activities were almost as limited in industries as the industrial hygiene activities. Although statistics which are directly comparable to data for industries in the United States were not available for all Japanese industries, in one iron and steel works that Japanese officials said had an active safety program and reported all lost-time injuries, accident frequency rates varied from two to five times as high as comparable American rates during the last 6 years. Its rate of 35 lost-time injuries per million man-hours for 1944 was four times that for comparable United States industries.

The prewar organization and program of the national and prefectural governments for the promotion of industrial health appeared fairly adequate. Under the stress of wartime conditions and the military seizure of control, however, the organized control of health in factories was largely dissipated. The division of functions and responsibilities for industrial health problems between the health and police departments at prefectural and subprefectural levels, the reduction of medical personnel despite increasing problems, and the wartime ban on the collection of statistics such as occupational diseases, did much to minimize the effectiveness of these groups. The larger and more modern factories employed physicians, the small factories depended on parttime physicians or upon assistance from the prefectural governments, and the small household industries and shops had no systematic health supervision. In the factories employing physicians, health supervision deteriorated during the war because of limitations of personnel, supplies and equipment, and the growing load upon the medical departments. After the air raids, many of the plants in target areas suffered serious or total disruption of their medical services.

References

Army Service Forces Manual M 354–13. Civil Affairs Handbook; Japan. Section 13, Public Health and Sanitation. Army Service Forces, Washington, D. C. 10 Feb 45.

Vernon, H. M.: The Health and Efficiency of Munitions Workers. Oxford University Press, London, 1940.

Kossoris, M. D.: Hours and Efficiency in British Industry. Monthly Labor Review, 52:1337 (June) 1941.

Industrial Health Research Board, Medical Research Council, Great Britain; Hours of Work, Lost Time, and Labour Wastage. Emergency Report No. 2 H. M. Stationery Office, London, 1942.

Flinn, Robert H.: Industrial Fatigue: Causes and Control. Chapter 16 in Manual of Industrial Hygiene. U. S. Public Health Service. W. B. Saunders Co., Philadelphia, 1943.

Medical Branch Report: The Effect of Bombing on Health and Medical Care in Germany. U. S. Strategic Bombing Survey. War Department, Washington D. C. 30 October 1945.

Flinn, Robert H. Absenteeism versus Ordnance Production. Industrial Medicine, 14:12 January 1945.

Hilleboe, H. E. and Gillespie, E. J. The Role of the General Practitioner in Tuberculosis Control. J. Mich. State Med. Soc. 44:1071, October 1945.

War Department Technical Bulletin: TB MED 160, Medical and Sanitary Data on Japan. Washington. May 1945.

VI. AIR-RAID CASUALTIES

NUMBER OF AIR-RAID CASUALTIES

Sources of Information

The most direct effect on health of air attacks is found in the deaths and injuries resulting from bombing of populated areas. Unfortunately the confusion during and immediately after bombing handicapped the collection of accurate casualty data so that a broad margin of error probably exists in the information obtained.

A record of air-raid casualties for 163 Japanese cities, showing totals of injuries and deaths in each city from the beginning of the bombings in November 1944 to the end of the war in 1945, was provided in a report secured by the Survey Civilian Defense Division (Appendix C–1). This report was compiled by the Japanese Air Defense General Headquarters and after the dissolution of that agency, was revised and completed by the Ministry of Home Affairs. This report shows a total of 235,616 deaths and 265,556 injuries, but is not complete. For 3 of the 163 cities listed, no totals of deaths and injuries are shown. One of these three cities, Kagoshima, had a population of 190,925 in 1944 and, according to the report of the Twentieth A F, 44 percent of its urban area was destroyed by bombing. The other two cities were small and their casualty totals consequently less significant. Another report, also secured by the Civilian Defense Division from the Japanese Ministry of Home Affairs, lists casualties for the entire country by prefectures. It indicates totals of 269,187 deaths, 109,861 serious injuries and 195,517 slight injuries, or 574,565 casualties in all.

The completeness of the listing of bombed cities shown in the report on the 163 cities may be tested by comparing it with that found in the record of bomb tonnage dropped on urban areas in Japan by all United States Army and Navy planes. The urban area tonnage computations included 125 of of the 163 cities for which casualties were reported, and these 125 cities accounted for 98.5 percent of the total bomb tonnage dropped on urban area targets in Japan. They also accounted for 99.5 percent of the total casualties reported for the 163 cities. This indicates that the 125 cities covered by both of these reports constitute a fairly complete list of the cities the United States Army and Navy forces bombed and which the Japanese authorities stated sustained casualties.

The Ministry of Home Affairs report on the 163 cities includes casualty totals for the six large cities—Tokyo, Yokohama, Osaka, Kobe, Nagoya and Sendai—for which similar information was submitted to the Survey representatives by prefectural health division authorities. A comparison (Appendix C–2) indicates that the totals on deaths are similar, but that the Ministry of Home Affairs totals of injuries are considerably smaller than those provided by the prefectural health divisions. For two of the six cities the death totals are identical and for another they compare closely, while for the remaining three the differences counterbalance so that the total difference is less than 1 percent of the total deaths shown in either report. For injuries, the prefectural health division reports for all except one of the six cities show considerably larger totals than the reports of the Ministry of Home Affairs. For Tokyo the prefectural health division total is more than twice the Ministry of Home Affairs total, and for Kobe it is five times the total reported by the Ministry. For both of these cities the total injuries reported by the Ministry of Home Affairs also are considerably less than the total deaths shown in the same report for these cities, which suggests under-reporting of the injury totals in the Ministry of Home Affairs report. For the six cities the prefectural health division reports on injuries represent an increase of 81 percent over the corresponding totals reported by the Ministry of Home Affairs.

The implications of this comparison indicate that while the two reports support each other on deaths, the report of the Ministry of Home Affairs is conservative on its total of injuries. In view of this, and also the fact that the prefectural health divisions are more direct sources of information than the Ministry of Home Affairs, their totals rather than those provided by the Ministry of Home Affairs for these six cities will be used in further discussions of air-raid casualties in this chapter.

The Ministry of Home Affairs report on casualties for Hiroshima and Nagasaki, the cities on which atomic bombs were dropped, is also extremely conservative. Its total of 55,855 deaths is less than half of the 120,000 deaths settled upon by Survey Medical Division representatives who visited these cities, and its total of 87,269 injuries is also considerably less than the Medical Division total of 160,000 injuries (Appendix C–2). Since the Medical Division total of injuries and deaths for these cities are the result of careful study by investigators who visited the cities, they will be used in further discussion in this chapter instead of the totals reported by the Ministry of Home Affairs.

Introduction of all the changes discussed above into the total of deaths and injuries reported by the Ministry of Home Affairs raises the totals for the 163 cities to approximately 300,000 deaths and 433,000 injuries or 733,000 casualties in all. A similar change in the more complete report for all prefectures raises the Ministry totals to 330,000 deaths and 473,000 injuries or 806,000 total casualties for the entire country.

It is rather surprising to note that this civilian casualty total is larger than that covering combat casualties for the armed forces. The military casualty total settled upon by the Military Analysis Division of the United States Strategic Bombing Survey is 778,550. This covers land action outside of the Home islands and Formosa. It is 25,000 less than the total of 806,000 civilian air-raid casualties mentioned above. Comparison of the totals of deaths and injuries shows that the combat death total of 491,000 is half again as large as the 333,000 civilian deaths and the total of combat injuries, 287,550, is considerably smaller than the corresponding civilian total of 473,000.

Casualty Rates

Ninety-four of the 163 cities for which casualty totals have been reported had 100 or more casualties. These 94 cities account for 499,181 or 99.5 percent of the 501,172 total casualties reported for the 163 cities. Casualty rates for these 94 cities on the basis of their 1944 population—except for Tokyo, Yokohama, Osaka, Kobe, Nagoya, Sendai, Hiroshima and Nagasaki, for which more recent population information is available—are 14.2 deaths and 20.6 injuries, or a total of 34.8 deaths and injuries per thousand persons (Table 112).

These rates include those for Hiroshima and Nagasaki which are especially high since they include casualties produced by the atomic bombs. If casualties for these two cities are omitted, the rates for the remaining 92 cities are 8.7 per thousand for deaths and 13.3 for injuries or 22.0 inclusive.

TABLE 112.—*Air-raid casualty rates for 94 cities grouped by size of death rate*

	Number of cities	Number of casualties per thousand persons			Population	
		Deaths	Injuries	Total	Total population	Percent of total
Hiroshima and Nagasaki		224.3	299.1	523.4	535,000	2.6
15 and over	8	16.9	25.5	42.4	6,629,969	31.6
10–14	11	12.0	12.2	24.2	948,758	4.5
5–9	20	6.7	12.0	18.7	5,909,307	28.1
Under 5	53	2.1	2.9	5.0	6,970,179	33.2
92 cities (except Hiroshima and Nagasaki)		8.7	13.3	22.0	20,458,303	97.4
94 cities		14.2	20.6	34.8	20,993,303	100.0

Of these 94 cities, 8 with 31.6 percent of the population of the total group had death rates in excess of 15 per thousand. The high population proportion of this group of eight cities is largely due to the fact that it includes Tokyo and Kobe. All but one of the remaining six cities have populations of less than 100,000. The highest rate of 19.9 deaths per thousand persons was shown for Hamamatsu, a city of 162,816 persons in Shizuoka prefecture between Tokyo and Nagoya. The injury rate of 17.9 per thousand persons in this city was also high. Death rates of less than five per thousand were reported by 53, or more than half of the 94 cities, and these 53 cities contain 33.2 percent of the population of the entire group.

Casualties and Size of City

When casualty rates of these 92 cities (exclusive of Hiroshima and Nagasaki) are grouped by size of city it is evident that considerably higher rates are shown for cities of 300,000 and over than for cities under that size (Table 113).

This is due both to repeated and intensive bombing of the metropolitan cities and also to the fact that bombing of wide areas in these large cities rendered escape much more difficult than in the smaller cities where the distance to the perimeter of the area set afire was not so

TABLE 113.—*Air-raid casualty rates for 92 cities grouped by size of city*

Population of city	Number of cities	Number of casualties per thousand persons			Total population	Percent of total population
		Deaths	Injuries	Total		
300,000 and over	10	10.8	17.6	28.4	12,084,575	59.2
200,000–299,999	9	4.8	8.6	13.4	2,136,505	10.4
100,000–199,999	21	6.4	6.8	13.2	2,898,690	14.1
Under 100,000	52	5.8	6.0	11.8	3,338,533	16.3
All cities	92	8.7	13.3	22.0	20,458,303	100.0

great. The effect of this latter factor is more clearly shown in the higher casualty rate per thousand tons of bombs dropped on these larger cities, and is described in some detail in a later section. The cities with populations of 300,000 or more show a casualty rate of 28.4 per thousand, which is over twice as high as that for cities of 200,000-300,000 population. The casualty rates for the cities under 300,000 population also decreased with size but the decrease is not pronounced and the death rate of 4.8 for cities of between 200,000 and 300,000 population is lower than that for smaller cities. The group of 10 cities of 300,000 or more includes all the cities of this size in Japan except Hiroshima, and the group of 9 cities of between 200,000-300,000 includes all the cities of that size except Nagasaki and Shappiro. Hiroshima and Nagasaki, as has already been stated, have been omitted from this classification because of their higher casualty rates resulting from the atomic bombs, and Shappiro is the chief city of the northern island Hokkaido, which was not severely bombed. The 10 cities of more than 300,000 population include Kyoto which was bombed very slightly, reporting only 296 casualties. This group of cities also includes five other cities besides Kyoto with populations of more than 500,000, namely, Tokyo, Osaka, Nagoya, Yokohama and Kobe. These cities had uniformly high casualty rates; the highest was Kobe's 47.4 per thousand, with Tokyo's 42.9 per thousand only slightly lower, and Nagoya's 16.6 per thousand being the lowest.

The average for the five cities was 34.5 casualties per thousand persons which is more than a third higher than the average of 22.0 per thousand for the 92 cities. Of these 34.5 casualties, 13.0 or about one-third were deaths. It may be noted that for these cities the death rate from bombing alone is slightly larger than the normal annual death rate from all causes for the United States.

TABLE 114.—*Air-raid casualty rates for 5 largest cities (except Kyoto)*

[Rate per thousand population]

	Tokyo	Osaka	Nagoya	Yokohama	Kobe	Total
Deaths	16.7	6.1	7.3	5.9	15.3	13.0
Injuries	26.2	13.7	9.3	18.2	32.1	21.5
Total	42.9	19 8	16.6	24.1	47.4	34.5
Population	5,469,000	1,726,000	1,131,000	781,000	632,000	9,739,000

Casualties and Bomb Tonnage

A study of air-raid casualties in relation to the tonnage of bombs dropped has been made for 81 cities for which the total of casualties reported is in excess of 100 and for which the information on bomb tonnage dropped is clear. The bomb tonnage reported for these cities is 84 percent of the total tonnage reported for the entire country. The average number of casualties per thousand tons of bombs for these cities was 1,305 deaths and 1,990 injuries or a total of 3,295 casualties.

Four cities reported deaths in excess of 2,000 per thousand tons of bombs dropped and their rates were all exceedingly high, the lowest being 4,492 deaths per thousand tons of bombs. The highest, Tokyo, showed 5,633 deaths and 8,515 injuries per thousand tons of bombs dropped. The other three cities in this category were relatively small, being less than 150,000 population. Three-fourths of the cities comprising more than 40 percent of the entire population reported deaths which averaged less than 1,000 per thousand tons of bombs dropped. The rates for injuries maintained a rather constant ratio to death rates for all categories. They averaged about 60 percent of the total casualties and ranged from 58 to 65 percent for the various groups shown in Table 115.

Casualties, Bomb Tonnage and Size of City

When air-raid casualties per thousand tons of bombs dropped are studied by size of city (Table 116) the most striking observation is the tremendously higher rates which prevailed for the cities of 300,000 population and over. The rates for both deaths and injuries were more than two and one-half times as high as the next highest rates, which were for cities of between 200,000 and 300,000 population. For all cities the rate increased constantly and rather rapidly with size of city, but the in-

TABLE 115.—*Air-raid casualty rates for 81 cities grouped according to number of deaths caused per thousand tons of bombs dropped*

Deaths per thousand tons of bombs dropped	Number of cities	Population Total	Percent of total population	Number of casualties per thousand tons of bombs dropped			Bomb tonnage
				Deaths	Injuries	Total	
2,000 and over	4	5,707,402	30.6	5,616	8,403	14,019	16,869
1,500–1,999	7	1,650,652	8.9	1,717	3,134	4,851	7,908
1,000–1,499	9	3,383,056	18.1	1,312	2,294	3,606	16,469
500–999	23	3,948,243	21.2	735	1,025	1,760	47,474
Under 500	38	3,960,235	21.2	245	342	587	46,330
Total	81	18,649,588	100.0	1,305	1,990	3,295	135,050

crease was not as pronounced for the smaller cities as it was for these two top groups. A major reason given for this increase in casualty rates with increase in size of city was that a greater area was covered by a single bombing raid in the larger cities and there was consequently greater difficulty in escaping from such areas.

A comparison of the population of these groups of cities shows more than half (59.6 percent) of the people residing in these 81 cities were in the nine largest cities having the heaviest casualty rates in relation to tonnage of bombs dropped. The other three groups have the remaining half of the population rather evenly distributed among them.

The percentage of casualties which were injuries ranged from 64 percent for cities of between 200,000 and 300,000 population to 50 percent for cities of under 100,000 population, with an average of 60 percent for all 81 cities.

Monthly Casualty Totals for Five Largest Cities

Information on casualty totals is available for each month of the bombing period for the five largest cities bombed, Tokyo, Yokohama, Osaka, Nagoya and Kobe. Correlation of these casualty totals with bomb tonnage dropped on these cities by month (Figure 32) shows a varied relationship between these two factors. There is a possible explanation for the records of casualties of Yokohama in April and for Kobe in August which are unsupported by records of air raids on these cities during these months. The bombing raids which produced these casualties are recorded as bombings of the industrial cities of Kawasaki adjoining Yokohama and Nishinomiya adjoining Kobe. Actually the raids were directed against these areas without regard to the boundary lines of the different municipalities but are recorded as against Kawasaki and Nishinomiya because most of the bombed areas lay within these cities rather than the adjoining cities of Yokohama and Kobe. However, the resulting casualties in Yokohama and Kobe were reported by these cities and so appear here as part of their record. Outstanding among the casualty totals is the 186,961 reported for Tokyo in March 1945. This total is accounted for almost entirely by the raid of 9 March which caused 185,657 casualties, 83,600 of them being deaths and 102,057 injuries. There were 1,665 tons of incendiary bombs reported for this raid, which indicates a rate of 112 casualties per ton of bombs in contrast to the average of 3.3 casualties per ton of bombs which prevailed for the 81 cities or the 5.7 casualties per ton of bombs which prevailed for the nine large cities (Table 115). The foremost reasons given for the exceedingly large number of casualties resulting from this raid were that this was a surprise raid and that the

TABLE 116.—*Air-raid casualties per thousand tons of bombs dropped for 81 cities grouped by size of city*

Size of city	Number of cities	Population totals	Percent of total population	Number of air-raid casualties per thousand tons of bombs			Bomb tonnage
				Deaths	Injuries	Total	
300,000 and over	9	11,119,176	59.6	2,152	3,520	5,672	60,549
200,000–299,999	9	2,136,505	11.4	809	1,439	2,248	12,807
100,000–199,999	19	2,528,555	13.6	755	811	1,566	24,109
Under 100,000	44	2,865,352	15.4	462	471	933	37,585
Total	81	18,649,588	100.0	1,305	1,990	3,295	135,050

area hit was closely built-up and thus conducive to the development of large conflagrations. In May about four times as many tons of incendiary bombs were dropped on Tokyo as were used in the March raid, but the May casualty rate was only about one-sixth as large as that of March. The May casualty rate of 4.7 per ton of bombs approaches the previously mentioned averages of 3.3 for the 81 cities and 5.7 for the nine largest cities.

Examination of the data for the other four cities indicates that there is no other monthly record that approaches that of Tokyo for March.

The May record for Nagoya shows a high tonnage of bombs with a comparatively low casualty total. The reason given for this was the difficulty of securing effective results in the incendiary bombing of Nagoya. The built-up area was so interspersed with open spaces that it was very difficult to develop large conflagrations, and casualty totals were consequently low due to the comparative ease of escape from the area set afire. In contrast, the high-explosive bombing of factory areas in June produced a rather large number of casualties. It may be noted that this June record for Nagoya is the only one shown in Figure 32 in which deaths exceed injuries. The ratio of deaths to injuries varied considerably but only for this one month did the number of deaths actually exceed injuries.

Casualties and Percentages of Built-Up Areas Destroyed

For 59 of the 94 cities for which casualty rates are shown, the percentage of the built-up area which was destroyed by bombing has been reported by the Twentieth A F (Appendix C–1). These percentages of area destroyed range from 17.9 to 99.5. Table 117 groups these 59 cities by percentage of built-up area destroyed and shows casualty rates for each group. This reveals a rather close correlation between total casualties and also deaths and injuries taken separately for cities having less than 60 percent of their built-up area destroyed.

For cities with 50 to 59 percent of their built-up area destroyed the rates for total casualties (injuries and deaths) are all exceptionally high. Study of the casualty rates of the cities making up this group shows that these high over-all rates are due to the fact that the group includes Tokyo and Kobe, both of which had casualty rates considerably higher than those of other cities in the group. If these two cities are omitted the rates of this group of cities having 50 to 59 percent of their built-up area destroyed drop to 6.7 for deaths, 12.3 for injuries, and 19.0 for total casualties. Use of these rates for the cities having 50 to 59 percent of their built-up area destroyed produces a series of death rates which increase constantly with the percentage of area destroyed except for a slight drop for cities having 80 to 89 percent of their area destroyed. For injuries and total casualties the correlation also holds for all groups except the two having 70 to 79 and 80 to 89 percent of their areas destroyed.

The one city which is listed as having more than 90 percent of its area destroyed is Toyama, the capital of Toyama prefecture. This city was reported 99.5 percent destroyed, with a casualty rate of 37.0 per thousand population. This damage was largely the result of an intensive bombing on the night of 1 August 1945.

TABLE 117.—*Air-raid casualty rates for 59 cities grouped by percentage of built-up area destroyed*

Percentage of area destroyed	Number of cities	Number of casualties per thousand population			Population total	Percent of total population
		Deaths	Injuries	Total		
90–100	1	13.4	23.6	37.0	160,531	1.0
80–89	4	8.0	8.5	16.5	334,089	2.0
70–79	11	9.6	8.7	18.3	1,118,871	6.6
60–69	7	7.9	16.6	24.5	723,887	4.3
50–59	7	16.0	25.3	41.3	6,660,077	39.6
40–49	10	6.2	10.0	16.2	2,045,577	12.2
30–39	10	5.8	10.0	15.8	3,975,107	23.6
20–29	8	4.2	4.3	8.5	1,523,207	9.1
10–19	1	3.8	1.9	5.7	265,218	1.6
All cities	59	10.2	15.7	25.9	16,306,614	100.0

NATURE OF AIR-RAID CASUALTIES

Background

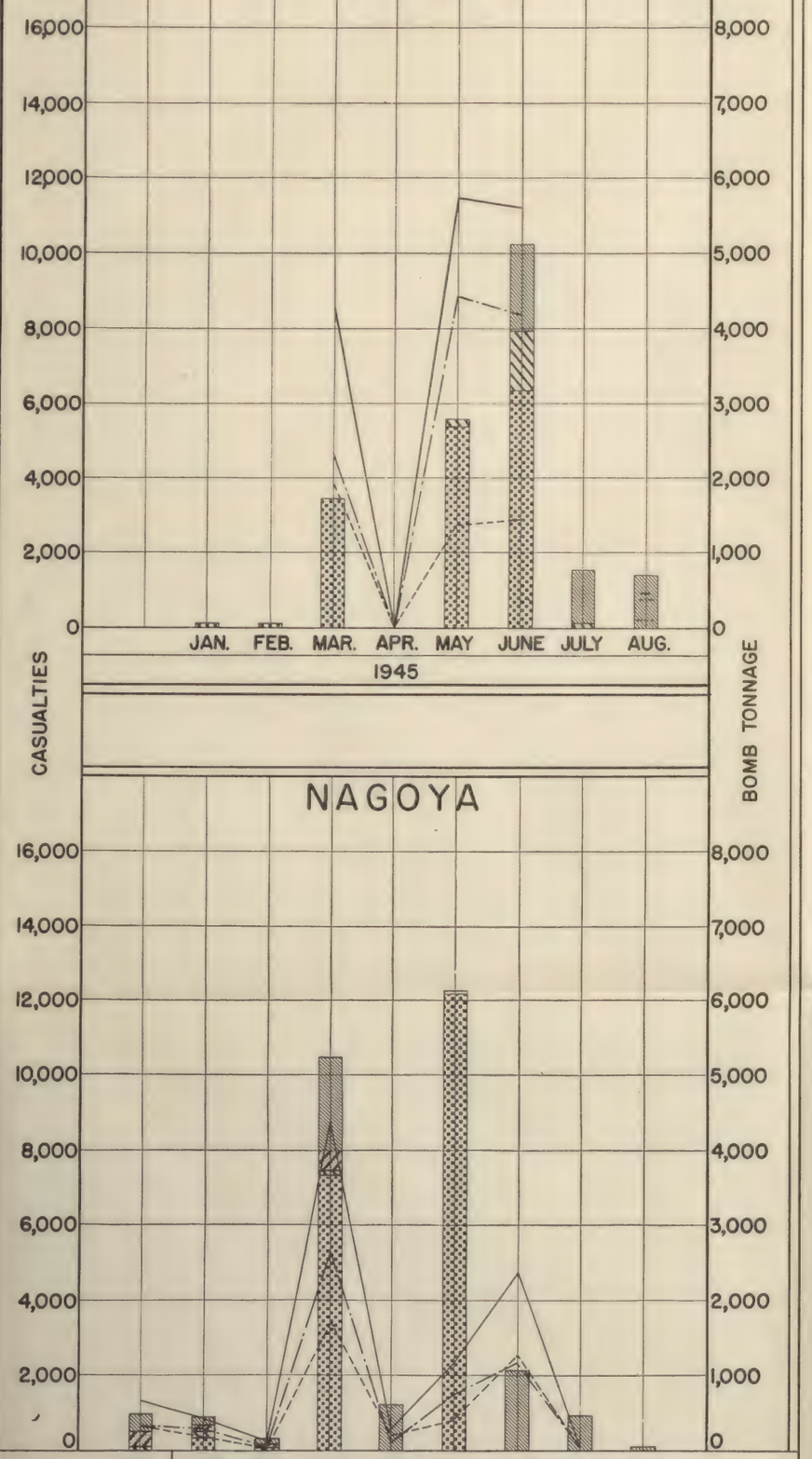
Information relative to the nature of air-raid casualties in Japan was extremely limited and difficult to obtain. The lack of any official or unofficial scientific studies in the field was rather shocking. This is especially true when one is acquainted with the great mass of data which was collected by the Germans during the period of their bombing. A review of the Medical Division report on "The Effect of Bombing on Health and Medical Care in Germany," reveals the many detailed studies conducted by

TOTALS OF CASUALTIES AND BOMB TONNAGE

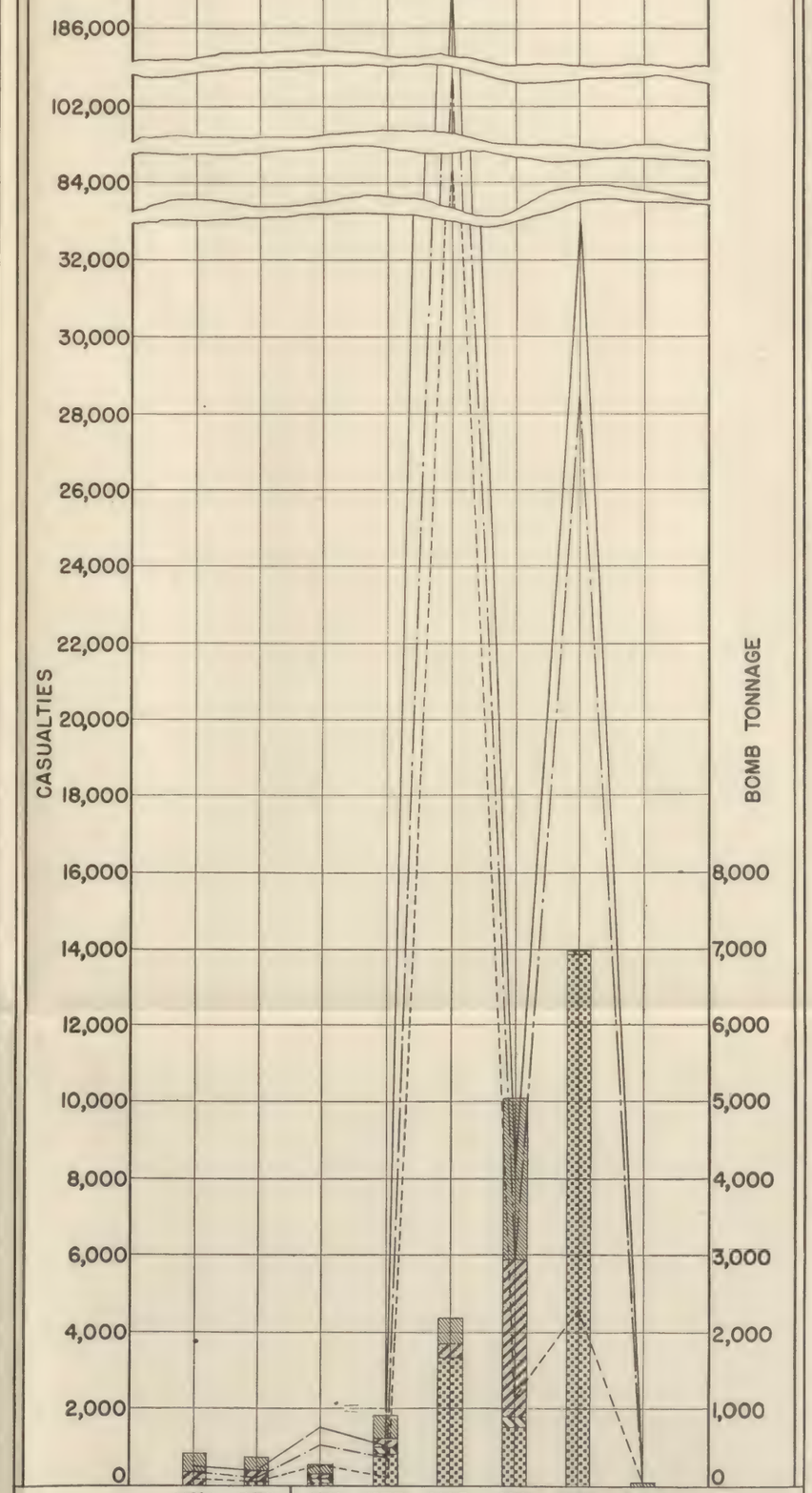
TOTAL
INJURED
DEATHS

H.E. & FRAGMENTATION
INCENDIARY
—URBAN AREAS
H.E. & FRAGMENTATION
INCENDIARY
—NON-URBAN AREAS

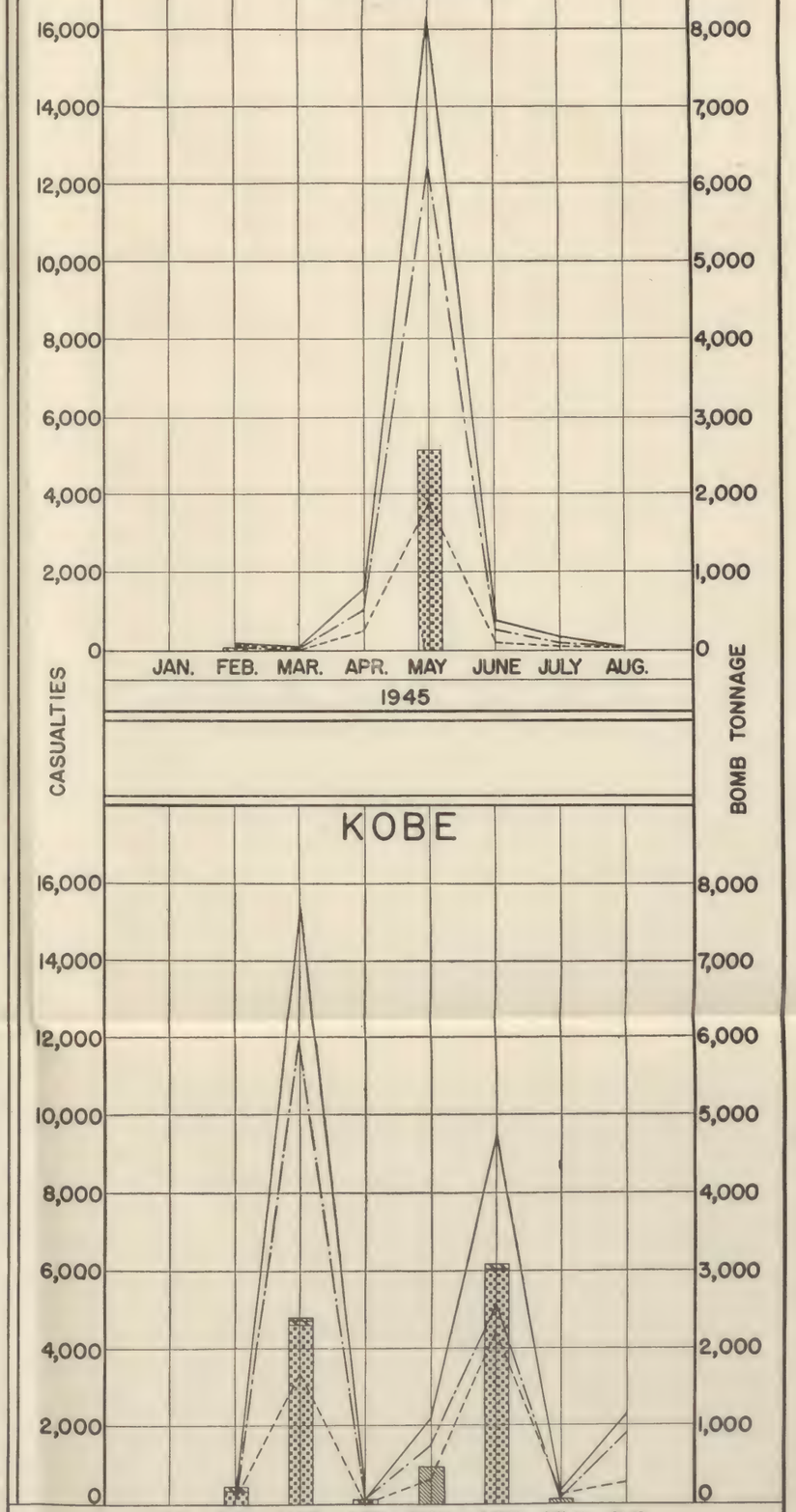
OSAKA



TOKYO



YOKOHAMA



NAGOYA

KOBE

FIGURE 32

the Germans in an attempt to indicate the exact causes of injuries and deaths during air raids. Special commissions were appointed by the Reich Ministry of the Interior and Luftwaffe to study the causes of death in air raids and to examine both injured and uninjured survivors. It was officially estimated by the Germans that 20,000 to 30,000 autopsies were performed on air-raid victims during the war and countless injured persons were examined.

The contrasting paucity of information relative to air-raid casualties in Japan was almost unbelievable. Detailed investigation in the various ministries of the imperial government and in several of the larger medical colleges failed to reveal any studies with the exception of those related to the atomic bombings. Even in the case of the atomic bombings it is difficult to know what the Japanese would have done had they been left to their own initiative. Since the war was concluded so shortly after the atomic bombs were dropped most of the studies of these effects were done after the end of the war and much of it under the direction of United States scientists. The Medical Division was unable to find evidence of a single group organized for study, or even a single autopsy performed relative to the nature of the casualties by incendiary and high-explosive raids on Japanese cities. No one in a sufficiently high position for his opinion to be worthy of consideration seemed to appreciate the need of such information.

Since there had been no scientific studies it was extremely difficult to gather information relative to the air-raid casualties. All information had to be gathered piecemeal. Physicians, air-raid workers and police were interviewed in several of the Japanese cities which were subjected to bombing. They were interrogated with reference to the type of injuries, the treatment given, the outcome of these injuries, and the character and circumstances of the deaths in the various air raids. Finally, more specific information relative to the distribution of casualties among the various types of injuries and deaths in several large Japanese cities was obtained from the health divisions of the prefectures in which these cities were located.

Causes of Deaths in Four Japanese Cities

Information relative to deaths was obtainable from four cities of Japan, Kobe, Nagoya, Sendai and Tokyo (Table 118). Percentage distribution by cause for all deaths was obtainable for Kobe and Sendai, and for 90 percent of the deaths in Nagoya, but for less than one percent in Tokyo. The data on Tokyo does not represent a satisfactory sampling and is a report of deaths occurring in only 13 hospitals. Thus all instantaneous deaths or other deaths which occurred before the patient could be removed to the hospital were not included. Therefore, no special significance can be attached to the Tokyo record, but it is of interest to see to what extent this record supports that of the other cities.

TABLE 118.—*Percentage distribution by cause for deaths resulting from air raids on four large cities*

Cause of death	Kobe	Nagoya	Senday	Tokyo	All cities
Burns	84.6	25.6	76.4	56.1	59.2
Effects of bomb blast	4.7	53.7	8.8	18.3	25.3
Crushing and suffocation		9.2	9.5	12.9	4.7
Gunshot wounds		.1	5.3		.4
Other	10.7	11.4		12.7	10.4
Total	100.0	100.0	100.0	100.0	100.0
Total deaths in above distribution	9,209	7,481	1,167	574	18,431
Total deaths reported	9,209	8,240	1,167	93,329	111,945

For three of these cities (Kobe, Sendai and Tokyo) the pattern of causes is reasonably uniform. Burns stood first by a rather wide margin, while the effects of bomb blast, and crushing and suffocation held about equal prominence as second and third causes. Gunshot wounds resulting from machine gun strafing was given as the cause of 5.3 percent of the deaths in Sendai. In contrast to these three cities, Nagoya showed the effect of bomb blast as the major cause of deaths while burns were in second place. This difference from the record of other cities is also apparent in the injuries reported from Nagoya (Table 119).

Cause of Injuries in Five Japanese Cities

Data relative to the distribution of injuries by cause were available for five Japanese cities (Table 119). However, for only two cities did this information cover all of the air-raid casualties reported. For Nagoya the study on the type of injury was limited to an investigation of the records of patients admitted by six hospitals for treatment of injuries and constitutes 72 percent of the total injuries reported for the city. The reports for Osaka embrace 77 percent of the total injuries. For Tokyo, the information

was limited to admission to 13 hospitals and represented only eight percent of the total reported injuries.

None of the reports were very specific in terminology and many had to be regrouped to conform to a uniform nomenclature before they could be compared with the data obtained from other cities.

TABLE 119.—*Percentage distribution by cause for injuries resulting from air raids on five large cities*

Injury	Kobe	Nagoya	Sendai	Tokyo	Osaka	All cities
Burns and other effects of fire and smoke.	82.7	18.8	75.0	45.4	39.6	42.7
Disorders of the eye	----------	11.5	.6	30.8	31.2	28.3
Effects of bomb blast	----------	8.7	14.0	6.9	----------	2.8
Fractures and dislocations.	9.2	12.2	.8	3.9	4.3	6.8
Bruises and lacerations.	8.1	48.7	9.6	7.0	14.1	14.9
Other	----------	.1	----------	6.0	10.8	4.5
Total	100.0	100.0	100.0	100.0	100.0	100.0
Total injuries in above distribution.	10,914	19,239	20,702	7,554	1,909	60,318
Total injuries reported.	141,083	24,720	20,702	10,519	1,909	198,933

Burns and other effects of fire and smoke took place among the causes of injuries for four of the five cities. Sendai, Nagoya, Osaka and Tokyo reported separately disorders of the eye, and for the latter two cities this condition accounted for 30 percent of all injuries. While Kobe did not list disorders of the eye as a separate cause, its percentage of injuries due to burns and other effects of fire and smoke is as large as that attributed to this cause and disorders of the eye taken together for either Sendai, Osaka or Tokyo. It has, therefore, been assumed that the two causes were listed together for Kobe. Disorders of the eye have been defined as conjunctivitis and other effects of exposure of the eye to smoke, gas and heat. It can readily be seen that these two causes are a subdivision of the grouping called burns and other effects of fire and smoke. It may thus be said that 70 to 83 percent of the injuries for four of the five cities were due to the effect of fire and smoke. Disorders of the eye when reported separately accounted for nearly 50 percent of the total injuries attributed to smoke, gas and heat.

Reference to Tables 118 and 119 reveals that the percentage distribution by cause for both deaths and injuries in Nagoya showed considerable departure from the trend in the other cities. Effects of bomb blast was by far the most prominent reported cause of death in Nagoya while in the other cities it was of much less importance. Again, in the report of injuries, bruises and lacerations was the first cause in Nagoya with fractures and dislocations more prominent than in the other four cities. These data suggest the possibility that high-explosive bombs may have been responsible for a larger portion of the casualties in this city than in the others for which records were obtainable. Unfortunately, information is not available showing the cause of casualties for each air raid, but totals of casualties and of bomb tonnage are available for each month. Study of these figures indicates that the number of casualties sustained in June was one-fourth of the entire total for Nagoya and that the casualty rate per thousand tons of bombs dropped was almost twice as large as during any other month. These facts taken together with the fact that the June bombing was entirely with high explosives indicates that high-explosive bombs did play a prominent part in producing casualties reported for Nagoya. Another factor, mentioned by representatives of the Twentieth A F, was the difficulty experienced in securing satisfactory results in incendiary bombing of this city. The built-up area was sufficiently interspersed with parks and other open areas to make the development of large conflagrations very difficult. Thus there was a comparatively small number of casualties produced by incendiary raids, and the distribution figures on injuries and deaths show considerable differences from the data on the other cities.

Heat

As pointed out previously, heat was responsible for the large majority of both injuries and deaths in the bombing of Japan. Since the large preponderance of the bombing of the densely populated areas was incendiary and since cities were so inflammable, this fact was clearly anticipated. The crowded conditions and the almost wholly wooden construction of the Japanese cities made them an ideal target for incendiary bombing. In most of the larger cities "fire storms" were rather easily created by the wide dispersal of incendiary bombs. These "fire storms" were due to the rushing of cooler air from the perimeter toward the center of the

fire as the heated air of the burning area rose. Such incidents were seen in Germany but probably reached even greater proportions in Japan. The wind velocity near the edge of the fire often reached hurricane proportions and was capable of collapsing buildings and of sweeping persons off their feet. Incidents have been reported in which trees with trunks 2 feet in diameter were uprooted. These "fire storms" were particularly important since they in themselves produced casualties and in addition, such wind velocity interfered seriously with attempts of persons to escape from the burning areas.

In many of the Japanese cities fire lanes or firebreaks were constructed prior to bombing. These open strips were 36 to 120 feet in width and were created by the demolition of inflammable buildings. During the saturation bombing of cities the conflagrations were so intense and widespread that these relatively narrow open spaces offered but slight impediment to the progress of the fires. As pointed out in the report of the Civilian Defense Division, the fire lanes provided easy access for fire-fighting equipment to burning areas in small and more isolated fires, but the major purpose that they served in the large conflagrations was as an avenue of escape for persons in the area.

Generally speaking, in the course of massive burning of the Japanese cities practically everything in the path of the fire was destroyed. In the residential areas where there were only a few scattered, fire-resistant buildings literally everything was destroyed. The skeletons of brick or concrete buildings frequently remained erect but usually the interior was completely gutted by fire. In the business districts the number of fire-resistant buildings increased and in the central business areas of several of the cities many of the larger and more modern buildings were completely intact. The ability of these buildings to remain depended to a great extent upon the surrounding buildings or upon cleared areas about them which had been created by the demolition of more inflammable buildings. The value of such buildings for protection of their occupants against injury and death was not always reflected in their ability to withstand fire because many persons died in unburned buildings, particularly when such structures were surrounded by burning areas.

Due to the character of the raids, which for the most part were completely or largely incendiary, most of the Japanese were able to escape from their houses and other buildings if they attempted to do so. There were few reports of persons being trapped in buildings, except as a result of demolition bombing. However, when bombing of urban areas first began, many of the Japanese depended on air-raid shelters which they had constructed beneath their houses. When their houses were destroyed by fire these shelters were death traps for the occupants. As late as June 1944 pamphlets issued by the Ministry of Home Affairs advised the construction of shelters by excavating beneath the houses. However, after the first few urban raids the danger of such shelters was apparent and the government revoked this recommendation advising that shelters be constructed in open spaces and that open trench shelters be roofed over.

Usually with the development of saturation raids persons fled to shelters in open areas or tried to escape to parks or beyond the perimeter of the fires. The highly combustible Japanese buildings quickly burst into flame and there was but little time to escape. Naturally, in the larger fires there was more difficulty in reaching the perimeter and the number of casualties was correspondingly higher. Survivors recounted fleeing down streets in an effort to escape the flames only to find their path blocked on all sides by equally intense fires. Traffic jams developed and in many instances milling throngs were isolated and burned *en masse* (Figure 33). Following the fires it was common to find burned corpses littering the streets of the burned areas (Figure 34). Some were lying in positions in which they had fallen, others were in positions suggesting that they had attempted to rise after falling but were unable to continue, and still others were in groups as if they had huddled together for mutual protection. Many were burned beyond recognition, the remains actually consisting of the skeleton with only charred remnants of clothing and soft tissues. Others were less badly burned, their clothes completely charred, yet they could be identified. Mothers were found with infants on their backs or clutching at their sides (Figures 35 and 36). In all of these instances when the bodies were sufficiently intact, there was evidence of a struggle to escape the heat and flames.

FIGURE 33. *Burned corpses as found on the streets of Honjo Ku, Tokyo, on 10 March 1945.*

FIGURE 34. *Countless burned corpses littering the streets of Hanakawa Do, Tokyo, on 10 March 1945.*

Often the frightened or burned persons were able to make their way to the rivers or canals so common in Japanese cities. It was reported that during the great fire raid of 9–10 March over Tokyo, thousands fled to these bodies of water for protection. As the numbers increased in these narrow canals, thousands were stampeded beneath the surface and were drowned. On the exposed surfaces many must have suffocated due to the combined effects of carbon monoxide and the lack of oxygen. It is probable that a few were saved by these streams but in many instances they accounted for a very large number of the deaths (Figure 37). Similar accounts were obtained in cities other than Tokyo, especially Osaka.

Air-raid shelters in the Japanese cities offered little protection to the populace. The open or covered trench shelters which were so common, actually amounted to death traps in many instances. Occupants of shelters beneath destroyed homes or surrounded by burned buildings were killed in almost every instance. Most of them were burned beyond recognition. Where the shelters offered sufficient protection against flame and heat the occupants were commonly found to have succumbed without evidence of external injury. As was true of the German experience many of the unburned dead in shelters appeared to have died peacefully and without evidence of a struggle (Figures 38 and 39). Persons in fairly open areas also were reported to have died in a similar manner during the great fires. Tunnel shelters, which were dug into hillsides, were in general quite effective. In instances where the entrances were swept by flames, occupants were reported to have died of suffocation. A few of the more modern buildings had basements which were used as shelters. In many instances the occupants of these shelters escaped injury, but in others they succumbed to the effects of fire. The bodies of occupants of basement shelters often showed the effects of heat but more often were found to have died without evidence of outward injury.

In contrast to the German experience, the Japanese cities in general did not continue to burn for days after the raids. A few small areas did remain afire for long periods but in most areas the buildings were so highly combustible that they immediately burst into flames and were quickly and completely consumed. There was relatively little rubble under which bodies could be buried. All of the evidence indicated that during the fires very high temperatures were reached rapidly. All combustible material was soon destroyed and the flames died down much more quickly than in most of the German cities. As a result of these intense fires of short duration, few bodies were found that showed evidence of prolonged dry heat. The Medical Division was unable to learn specifically of any instances where the clothing was unburned and yet the bodies showed splitting of the scalp and other dessicating effects of prolonged heat. Substances, such as phosphorus, capable of producing chemical burns were not used in Japan.

Survivors showing the effects of heat were usually burned entirely or more severely upon the exposed surfaces. Burns about the head, neck and hands were common. The intensity of such burns varied from simple first-degree to severe third-degree burns. In some instances persons were able to survive burns which resulted from flaming clothing, but it is probable that in most instances the individual was unable to escape if exposed to fires of such great intensity.

Following the incendiary raids most of the inured persons were suffering from burns but many cases were complicated by fractures and other traumatic injuries. Some were given treatment on the scene and were dismissed to their homes. Most of those severely burned were transported directly to hospitals as soon as such facilities could be established. A large percentage, probably 25 to 50 percent, of the burned patients reaching hospitals died within a few hours or a few days.

Early in the course of the air raids tannic acid preparations were commonly used in the treatment of burns. However, due to the large amount of infection encountered in most cases this form of treatment was soon abandoned. Ointments and other preparations containing fats and oils were scarce or entirely absent. Phenol, one to two percent, was usually added to oils when they were available. Baths in antiseptic solutions were commonly employed in an effort to remove the devitalized tissues and to control infections. Tetanus antitoxin was fairly commonly employed in the earlier burned cases but supplies were inadequate and soon it was not given to patients unless there were severe

FIGURE 35. *Charred corpses of mother and child, 10 March 1945, Fukugawa Ku, Kasaki, Tokyo.*

FIGURE 36. *Charred remains of another mother and child, 10 March 1945, Fukugawa Ku, Kasaki, Tokyo.*

FIGURE 37. *Mortuary squad fishing bodies from water on 12 March 1945, Honjo Ku, Kikugawa Bashi, Tokyo.*

FIGURE 38.—*Bodies of victims of 9–10 March 1945 great fire raid on Tokyo as displayed in park for identification by relatives.*

FIGURE 39. *Another group of bodies in same park as shown in Figure 38 displayed for identification.*

FIGURE 40. *Mutilated remains of bodies as found in Yuraku Cho station, Tokyo, on 27 January 1945, following high-explosive raid.*

lacerations or compound fractures. Since the supplies of tetanus antitoxin were low the Japanese physicians apparently reasoned that it was not necessary anyhow, since they felt there was little danger of tetanus. As a result of this practice large numbers of the burned cases developed tetanus and died of this condition.

As mentioned previously, disorders of the eye was listed as a prominent cause of injuries in those cities reporting this condition separately. It was largely manifest as a conjunctivitis due to heat, smoke and gases, and was not a serious condition. Practically no patients required hospitalization for this condition alone but it was almost uniformly seen in patients hospitalized for other effects of heat. It usually consisted of congestion of the conjunctivae with photophobia and excessive lachrymation. Treatment consisted of lavage of the eye with boric acid solutions or physiological saline or by the installation of a cocaine solution. The process usually subsided within three or four days without permanent effects. In a few instances where there were severe burns of the face, the cornea was also damaged and partial loss of vision or more serious effects resulted. Some eye injuries also resulted from bomb fragments, flying debris and other mechanical causes. When these injuries occurred they usually were of more serious import.

Carbon Monoxide Poisoning

It was impossible to estimate the importance of carbon monoxide as a cause of deaths from air raids on Japanese cities. Such an entity was either not recognized or was not considered important by Japanese scientists. Though carbon monoxide poisoning was found to be responsible for a large percentage of the deaths in German cities subjected to bombing, the Japanese physicians were not cognizant of this fact. Official Japanese reports on the cause of deaths due to air raids did not list carbon monoxide poisoning. The closest approach to such a diagnosis was found in the reports on deaths under the heading of "crushing and suffocation."

This cause was reported responsible for 9.2 percent of the deaths in Nagoya, 9.5 percent in Sendai and 12.9 percent in Tokyo. Doubtless some of these deaths were due to crushing injuries, particularly in the high-explosive raids, but presumably suffocation was responsible for most of them. However, the percentage of deaths attributed to suffocation, if this group included the effects of carbon monoxide poisoning, is not as large as one would expect for raids which were preponderantly incendiary in nature. It seems probable that many deaths due to carbon monoxide were reported under the general heading of burns. A point in support of this contention is the fact that for Figures 38 and 39 the Japanese caption was, "March 12, 1945, 1400 hours, Scene of disposition at Ueno Minamidaimon of the burned corpses of Shitaya and Asakusa." Study of the photographs clearly reveals that these people show no evidence of burns or other outward injury. From their appearance and the knowledge that they died during the great fire raid in Tokyo of 9–10 March it seems justifiable to assume that they died of carbon monoxide poisoning and lack of oxygen.

Interrogation of police, air-raid rescue workers and others who had the opportunity of seeing the bodies before they were removed for disposition, revealed that large numbers of such corpses were found in air-raid shelters and some in the open. Most of the death reports were prepared by such officials and since these bodies were found in burned-out areas or buildings it seems logical to believe that the deaths were reported as due to suffocation or to burns.

Apparently, the Japanese did not perform any post-mortem examinations to determine the cause of death in victims showing no evidence of injury. Further, representatives of the Medical Division were informed by several physicians in key positions that such bodies were not seen by the doctors as they were obviously dead and were not brought to the hospitals. When asked if they had considered the possibility of carbon monoxide poisoning, the usual reply was that deaths were considered due to suffocation from anoxia and that no studies were thought necessary.

Just as in Germany, and possibly even more so, carbon monoxide poisoning was probably responsible for a considerable percentage of the deaths from bombing. Though generally unrecognized by the Japanese as an important cause of death there was adequate evidence to this effect in Japanese photographs and accounts of conditions during and after the large incendiary raids.

Air Blast and Mechanical Injuries

True air blast is produced by the detonation of high-explosive bombs and does not occur in incendiary bombing. The injury produced in human beings is due to a wave of positive pressure followed by a negative pressure phase which radiates from the center of the explosion in a spherical fashion and rapidly dissipates itself. Even with the larger high-explosive bombs the radius of the severe effects upon man are limited to 100 to 200 feet. True blast injuries were usually manifest by perforation of the ear drums, tearing of the vital organs, especially the lungs, with resulting hemorrhages into these structures or air embolism, and inner ear deafness due to damage to Corti's organ.

More important features of the damage to persons produced by high-explosive bombs were the injuries produced by bomb fragments, flying debris and collapsing buildings. These mechanical factors were responsible for a far larger percentage of the deaths and injuries than true air blast. Persons very near direct bomb hits were often blown almost to bits (Figure 40). Injuries due to fractures, dislocations, bruises and lacerations were common injuries of this type. Shock was often a considerable factor in the more serious of these mechanical injuries. In general, however, these injuries did not differ from those commonly encountered in combat.

Apparently in the reports of the cities under observation in this study the title, "effects of bomb blast," in Tables 118 and 119 covers deaths and injuries resulting from air blast as well as those resulting from the mechanical effects of bombing except fracture, dislocations, bruises and lacerations. Deaths attributed to the effects of bomb blast constituted 25.3 percent of the total deaths for the four cities reporting this information. The percentages for the individual cities, however, varied widely, ranging from 4.7 percent for Kobe and 8.8 percent for Sendai to 53.7 percent for Nagoya. Injuries from this cause were reported as constituting 8.7 percent of the total for Nagoya, 14 percent for Sendai and 6.9 percent for Tokyo. Kobe and Osaka attributed no injuries to this cause.

The treatment of blast effects consisted largely of general supportive measures and rest. There was no evidence of any specific measures or any significant research in this field. Mechanical injuries were treated in conventional fashion, but the Japanese did not use plasma or whole blood to any appreciable extent.

SUMMARY

Information on air-raid casualties both as to casualty totals and also as to nature of casualties was quite difficult to find in Japan. The confusion at the time of, and immediately following, bombing handicapped the collection of accurate casualty totals. There was a surprising lack of interest in scientific studies in this field. Careful investigation in the various ministries of the imperial government and in several of the large medical colleges failed to reveal any studies except those related to the atomic bombings and these could generally be traced to foreign instigation.

Civilian casualties for the entire country as a result of bombing were estimated on the basis of information from various sources to total 806,000. Of these, 333,000 were deaths and 473,000 were injuries. For 94 cities reporting 100 or more casualties each, the casualty rates were found to be 14.2 per thousand persons for deaths and 20.6 per thousand persons for injuries if the atomic-bomb totals for Hiroshima and Nagasaki are included, or 8.7 for deaths and 13.3 for injuries if the totals for these two cities are excluded.

When casualty rates were grouped by size of city for the 92 cities reporting 100 or more casualties, exclusive of Hiroshima and Nagasaki, the 10 cities of 300,000 or more population were found to have a casualty rate more than twice as high as that for the next highest group. The rate for cities of 300,000 and over was 28.4 and that for the next highest group was 13.4. This next highest group was the cities with populations between 200,000 and 300,000 and rates continued to decrease slightly with the size of city although cities of less than 100,000 population reported the comparatively high casualty rate of 11.8 per thousand persons. The proportion of casualties which were deaths was considerably higher for the smaller cities than for the larger.

The ratio of casualties to bomb tonnage for 81 cities for which pertinent information was available was 3,295 casualties per thousand tons

of bombs. Of this total 1,305 were deaths and 1,990 were injuries. The rates covered by these averages varied quite widely. Four cities with 30.6 percent of the total population of the 81 cities had rates in excess of 2,000 casualties per thousand tons of bombs and 61 cities with 42.4 percent of the total population had rates of less than 1,000 casualties per thousand tons of bombs.

A very interesting correlation was found between the casualty rate per thousand tons of bombs dropped and size of city for the 81 cities for which this information was available (Table 116). For cities of 300,000 and over this rate was 5,672 casualties per thousand tons of bombs while for cities of less than 100,000 population the rate dropped to 933, or less than one-sixth of the top rates with rates for the medium-sized cities ranging between these two extremes. Greater population density and the ability to develop great conflagrations in the larger cities were given as two reasons for this increase with size of city of the number of casualties per thousand tons of bombs.

Outstanding among monthly casualty totals for the five largest cities bombed are the totals for Tokyo during March (Figure 32). During this month the notable raid of 9 March was made. The total of casualties reported for this raid was 185,657, which was at the rate of 112 casualties for each ton of bombs dropped in contrast to 3.3 casualties per ton shown as the average for 81 cities (Table 115).

Limited information on the nature of air-raid casualties indicates that, in general, burns were the outstanding causes of both deaths and injuries. They accounted for 59.2 percent of the deaths according to the records of four large cities and 69 percent of the injuries according to the records of five large cities. In the record of only one city, Nagoya, did other causes take precedence. For Nagoya, effect of bomb blast stood foremost as the cause of death and bruises and lacerations led as the cause of injury. This variation for Nagoya was attributed to a larger percentage of the casualties being produced by high-explosive bombs in this city than in the others studied. It was also noted that the percentage of total casualties which were deaths was much higher for Nagoya than for the four other cities.

It is natural to expect that burns would stand foremost as a cause of injuries and deaths resulting from bombing of Japanese urban areas with incendiary bombs. The cities were thickly populated; the light wooden buildings were easily ignited and burned rapidly; and the streets were narrow making escape difficult and this difficulty was increased by the development of large conflagrations from which escape to the perimeter was impeded by distance, the crowding of the streets, and also by the force of the "fire storm" winds rushing toward the center of the conflagration. Many casualties were due to relying on air-raid shelters under buildings or the use of open or closed trench shelters. Escape to parks and other open areas was the most effective precaution if such areas were within reach.

Lack of well-defined terminology in the reports describing the cause of casualties makes it difficult to give specific information in this field. The cases listed under the heading of burns included, of course, skin burns of any degree but were by no means limited to this type of case. In addition, fatalities listed under this heading might be due directly to burns or to tetanus or other secondary causes. Tetanus antitoxin was not generally used with the result that deaths from tetanus were not uncommon. A type of injury which was included in some cities under the classification of burns and which in such cases apparently accounted for nearly half of the cases listed under the heading of burns was injuries to the eye. Most of these injuries consisted of inflammation of the conjunctivae or other parts of the eye as a result of exposure to heat, smoke or gases, or photophobia as a result of exposure to the light of the flames. These injuries were not severe, rarely required hospitalization, and included very few fatalities. Carbon monoxide poisoning was not reported as a cause of death in Japanese reports on air-raid casualties, and no evidence was found of any effort to discover to what extent it might have been responsible for fatalities among air-raid victims. Many bodies were found, however, of persons who apparently had died without pain or struggle and this was characteristic of those found to have died of carbon monoxide poisoning in Germany. Most deaths of this sort in Japan were presumably reported under the heading of crushing and suffocation. There is evidence,

however, that where cases of this sort were found among victims who manifestly died from burns, they were all reported as victims of burning. The 9 to 13 percent of deaths attributed to crushing and suffocation in the four reporting cities, therefore, probably is underestimated if it is assumed that all cases of anoxia and carbon monoxide poisoning were included under this heading.

Next to burns the most frequent cause of death reported was the effect of bomb blast. Deaths reported under this heading apparently included both deaths as a result of damage to lungs and other vital organs produced by air blast, and also deaths resulting from the physical force of bombs or of flying missiles. Injuries attributed to the effect of bomb blast were much less numerous than deaths attributed to this cause. Some of the injuries which in the course of their treatment came to be classified according to type of injury as fracture, dislocations, bruises and lacerations may have also resulted from bomb blast.

VII. NOTIFIABLE DISEASES

CASE INCIDENCE

General

Fear of disease epidemics is aroused rather easily among masses of people anywhere and there is evidence that this fear is especially strong in Japan. Gauze masks covering the nose and mouth are a very common sight on the streets of Japanese cities indicating popular concern over the spread of disease and this is matched by the multitude of governmental health regulations and the care with which they are enforced. It is reasonable to consider therefore that disease epidemics resulting from bombing of urban areas was especially damaging to the morale of the Japanese people.

Study of the extent to which epidemics of disease resulted from bombing was made for the six largest cities of Japan, namely, Tokyo, Osaka, Yokohama, Kobe, Nagoya and Kyoto and also for the country as a whole. All of these cities, except Kyoto, were extensively bombed, having from a third to more than half of their built-up area destroyed. Kyoto was included in the study as a control city to aid in determining to what extent increased incidence of communicable disease during the bombing period might be due to factors other than bombing. In each of the six cities records were secured of monthly totals of cases and deaths from January 1941 through October 1945 for each of the following eight communicable diseases: dysentery, typhoid and paratyphoid fever, smallpox, typhus fever, scarlet fever, diphtheria and meningococcus meningitis. Similar records were also secured on totals of cases for the country as a whole. Two other diseases, cholera and plague, were also listed as reportable but no cases of plague had been reported in any part of Japan since 1926 and no cases of cholera since 1938.

Reports on these 10 diseases were required by law throughout Japan. The custom of submitting such reports was therefore well established and reporting is considered to have been reasonably complete. It was the normal procedure for infectious diseases to be reported to the authorities by attendant physicians, however in times of epidemic prevalence, police officers made an effort to find patients, who did not have a physician in attendance, by carrying out a house-to-house inspection. Investigations to determine the efficiency of the reporting procedure indicated that out of a total of 13,125 cases covered by the investigations, over 90 percent had been reported by attending physicians.

TABLE 120.—*Notifiable diseases discovered by various methods*

Method	Number of cases	Percentage
Reported by physicians	12,248	93.32
Notified by patient's family	16	.12
Discovered in household inspection	480	3.66
Discovered near persons examined	125	.95
Discovered in post-mortem examinations	12	.09
Secretly reported	52	.40
Others	192	1.46
Total	13,125	100.00

Population

Before entering on a study of communicable disease in these six cities it will be helpful to consider some pertinent characteristics of the populations involved. The outstanding characteristic was the rapidly reducing size of populations, especially during the air-raid period in 1945 prior to the surrender. The November 1945 census showed reductions in the populations of these six cities from that shown in the February 1944 census.

TABLE 121.—*Reduction in population of six principal cities from February 1944 to November 1945*

City	Percent reduction	City	Percent reduction
Osaka	61	Tokyo	47
Kobe	59	Yokohama	40
Nagoya	57	Kyoto	10

These reductions in population are for 1 November 1945 and do not represent conditions at the peak of evacuations. Monthly reports on population from Osaka and Nagoya indicate that Osaka reached its lowest population total in July when its report shows a 63 percent reduction; Nagoya reported a 60 percent reduction in October. For Osaka, Kobe and Nagoya, the most rapid reductions in population were shown by monthly reports to have oc-

curred following severe bombing of urban areas in March (Figure 41).

It is natural to expect that the evacuees would be preponderantly women and children. Analysis of sex ratios for the six cities under review, confirms this postulate and shows consistent preponderance of males in the 1945 populations of all the cities except Kyoto. The four cities for which the 1944 ratios are available show a considerable reduction in females in 1945.

TABLE 122.—*Sex distribution of six largest Japanese cities in 1944 and 1945*

City	Females per 100 males	
	1944	1945
Tokyo	109.7	95.1
Osaka	111.0	96.3
Kobe	108.4	99.8
Nagoya		99.8
Yokohama		96.4
Kyoto	118.8	113.0

A measure of the extent to which the proportion of children was reduced and the proportion of men was increased in these evacuated cities is provided in a comparison of the age and sex distribution of the 1945 populations of Osaka and Nagoya with a norm provided by a similar distribution of the combined populations of Tokyo and Kyoto in 1944 (Figure 42). The comparison shows a 20 percent reduction in the percentage of children under 15 years of age in Osaka and a 10 percent reduction for the same group in Nagoya over the 1944 percentages for Tokyo and Kyoto. The increases in the proportion of men 35 to 64 years of age was 31 percent for Osaka and 19 percent for Nagoya.

Information is not available on the extent to which the normal distribution of the populations among occupational and socio-economic groups was disturbed. It is presumed, however, that there was an increase in the number of industrial and relatively low-income workers though this probably did not lead to the crowding which would have resulted had it not been accompanied by extensive evacuation.

Probably the most significant of these population changes for the purposes of this study are the reduction in population densities and the decrease in the proportion of children. Crowding is a prominent factor in the spread of communicable disease and in the absence of age-specific data on the incidence of children's disease such as diphtheria, information on the proportion of children in the population is important.

In the calculation of case rates for notifiable diseases in the six principal cities of Japan for this report the total populations shown in Table 123 were used.

Dysentery, Typhoid and Paratyphoid Fever

Dysentery, typhoid and paratyphoid fever are the most prevalent in Japan of the eight communicable diseases covered by this study. Comparison of the records for these two disease groups, dysentery and typhoid and paratyphoid fever, shows that the annual case and death rates for dysentery (Table 124) are slightly higher and show somewhat wider variations than the corresponding rates for typhoid and paratyphoid fever (Table 125).

An outstanding characteristic of these tables is the tendency for the dysentery rates to decrease from 1941 forward through 1944 and for the typhoid and paratyphoid fever rates to increase during this same period or more specifically from 1942 forward.

This tendency holds with only a few exceptions for the rates of each of the six cities and for the rates for all Japan. Study of this phenomenon shows the presence of cyclical tendencies in the incidence of these diseases, with the typhoid fever cycle showing an upward trend and the dysentery cycle showing a downward trend during the period covered by this study (Figure 43), except that the dysentery rate rose slightly during 1944 and pronouncedly during 1945.

TABLE 123.—*Populations of the six principal Japanese cities used in calculations of case rates*

Year	Tokyo	Osaka	Yokohama	Kobe	Nagoya	Kyoto	Total, 6 cities:
1941	6,813,143	3,172,862	974,143	981,324	1,347,793	1,093,607	14,382,872
1942	6,877,954	3,117,310	991,708	963,083	1,377,669	1,099,066	14,426,790
1943	6,789,584	3,001,324	1,017,438	936,649	1,407,500	1,042,587	14,195,082
1944	6,327,247	2,666,668	1,001,347	887,713	1,373,450	945,437	13,201,862
1945	4,400,217	1,531,258	746,677	572,235	945,062	890,169	9,085,618

BOMBING EXPERIENCE
AND
EVACUATION OF POPULATION
1945

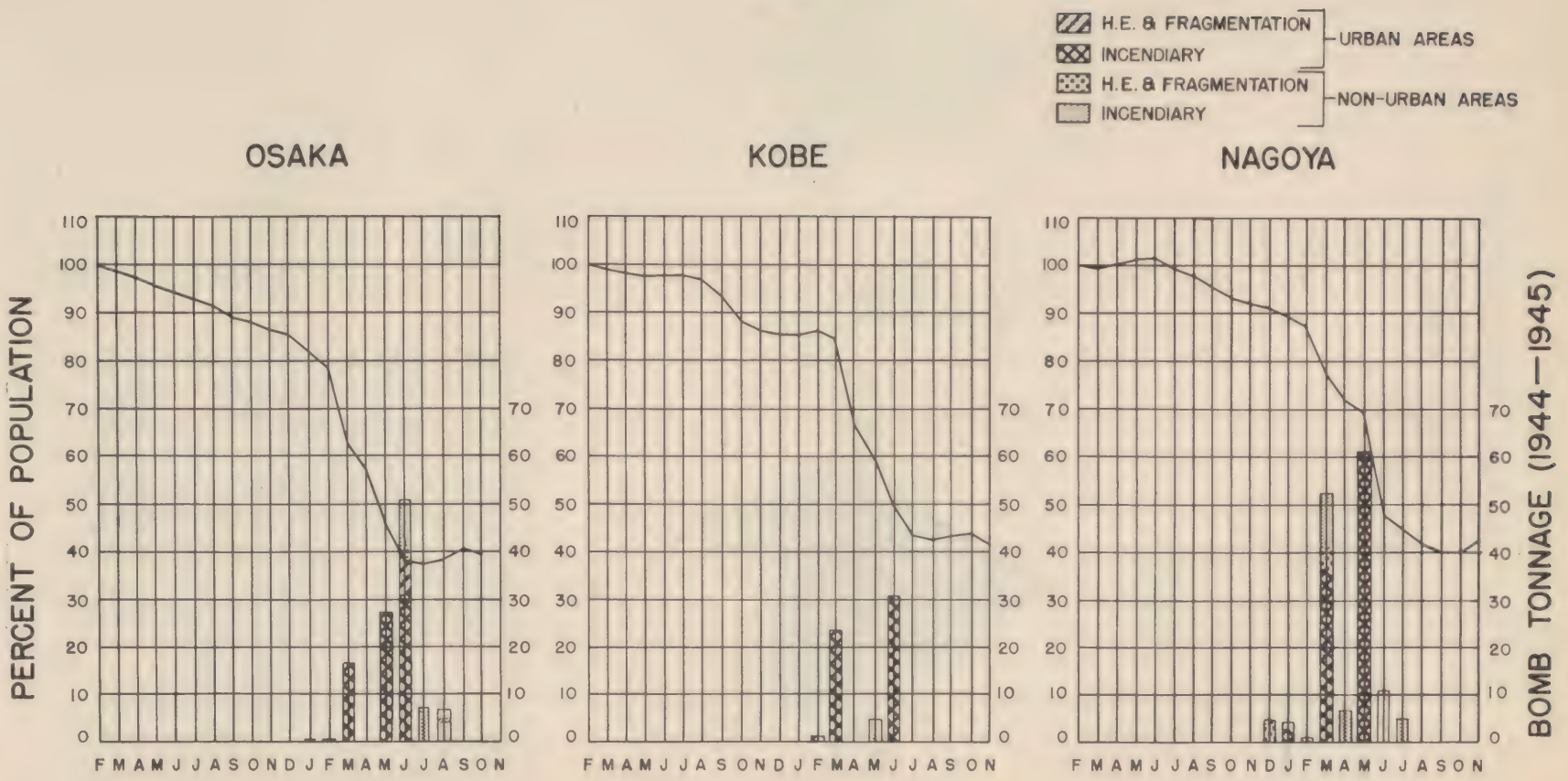


FIGURE 41

CHANGES IN AGE AND SEX DISTRIBUTION

OF URBAN POPULATIONS

1944 VS 1945

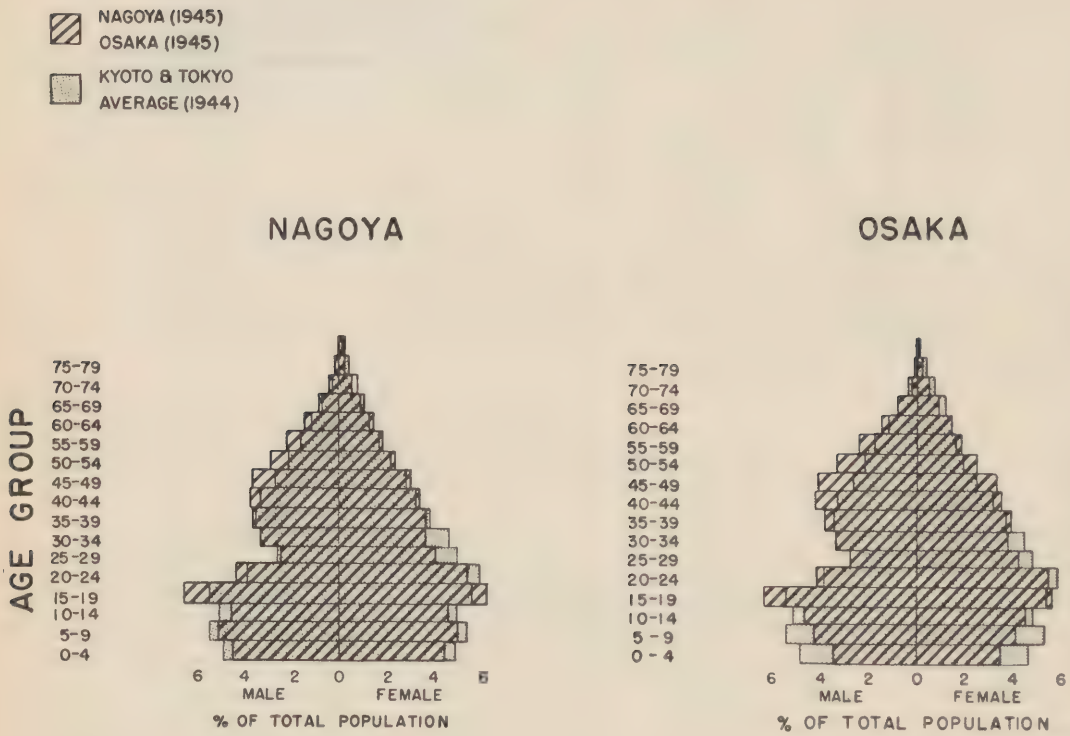


FIGURE 42

TABLE 124.—*Annual case and death rates for dysentery in the six largest Japanese cities and in all Japan from January 1941 through October 1945*

Year	Tokyo	Osaka	Yokohama	Kobe	Nagoya	Kyoto	Combined cities	All Japan
	Number of cases per 100,000 population per year							
1941	244.5	154.3	141.8	154.7	173.3	229.4	203.8	82.4
1942	218.7	164.8	122.1	178.3	194.9	202.4	194.3	78.6
1943	115.2	137.7	57.2	111.8	127.6	227.3	125.1	68.1
1944	71.3	56.0	55.5	91.1	101.2	112.9	74.3	74.9
1945	77.2	35.5	50.0	69.0	637.4	111.2	129.0	134.0
	Number of deaths per 100,000 population per year							
1941	41.5	26.1	(1)	30.9	57.9	38.3	38.5	(1)
1942	35.4	23.2	(1)	27.7	66.0	37.4	35.4	(1)
1943	15.0	23.1	(1)	23.2	49.9	15.0	21.2	(1)
1944	11.9	7.3	(1)	16.8	35.8	16.5	14.3	(1)
1945	11.8	4.7	(1)	14.9	124.9	23.3	24.8	(1)

[1] No report.

TABLE 125.—*Annual case and death rates for typhoid and parathyphoid fever in the six largest Japanese cities and in all Japan from January 1941 through October 1945*

Year	Tokyo	Osaka	Yokohama	Kobe	Nagoya	Kyoto	Combined cities	All Japan
	Number of cases per 100,000 population per year							
1941	60.6	85.7	113.4	125.7	127.0	73.7	81.4	65.6
1942	54.6	69.0	104.7	109.4	130.7	57.1	72.3	59.0
1943	147.4	130.9	211.2	189.8	223.5	115.7	156.5	88.9
1944	189.1	136.5	230.9	312.5	175.9	142.2	185.1	100.7
1945	79.8	47.0	183.7	472.2	262.2	181.4	136.5	84.9
	Number of deaths per 100,000 population per year							
1941	7.8	11.1	(1)	23.3	17.5	8.1	10.8	(1)
1942	6.3	6.7	(1)	19.7	17.3	7.5	8.6	(1)
1943	12.0	17.1	(1)	27.9	27.5	9.9	15.8	(1)
1944	12.4	24.1	(1)	61.0	25.4	23.1	20.8	(1)
1945	6.4	7.4	(1)	63.3	44.9	38.8	18.3	(1)

[1] No report

It is to be noted that the rates used in Figure 43 represent typhoid fever only, excluding paratyphoid fever, though paratyphoid fever is included in the rates shown in Table 125. Paratyphoid fever rates were not available for the earlier years covered in Figure 43 and it is felt that if included they would not materially affect the trend of the typhoid fever curve.

The turn upward in the dysentery curve, before the low point comparable to that of 1921 was reached, may probably be due to the effect of the war and more particularly to the bombing during 1945. Whatever the responsible factors were, their ability to reverse the normal trend of dysentery rates for all Japan in 1944 and 1945 and send them upward indicates greater strength than if these 1944 and 1945 rates were merely an acceleration of an upward trend which had already been developed, as in the case of the typhoid and paratyphoid fever rates.

On the other hand the typhoid and paratyphoid fever case rates for all Japan, Tokyo, Osaka and Yokohama (Table 125) show a break in their upward trends in 1945 which is rather difficult to explain. Reduction in crowding of densely populated areas may be a factor, for in the absence of some common vehicle of infection affecting large segments of the populations, dysentery, typhoid and paratyphoid fever are much more prevalent in those areas of a city where crowding and unsanitary conditions exist. The target areas in the bombed cities included such areas and with their destruction and the almost complete evacuation of population from them, many factors which normally contribute to the spread of infectious disease were removed. On the other hand, damaged public water supply systems which would permit pollution of the water used for drinking coupled with a lack of sanitary services and facilities, could account for the sharp increase in these diseases which reached epidemic proportions in some cities. These outbreaks are the best measure available of the immediate effect of bombing on the incidence of these diseases. Case rates for the months covered by the bombing period in the cities surveyed will be compared with corresponding rates for the same months for the previous 4 years to find periods when incidence was abnormally high. Such periods will then be made the subject of more careful study.

The record of dysentery will be considered first. The dysentery diagnosis group covers both bacillary and amoebic dysentery and a disease of children from 2 to 10 years of age known as Ekiri. Amoebic dysentery is the most frequent diagnosis in the group, with bacillary dysentery only slightly less frequent, according to information from the Osaka Infectious Disease Hospital. Bacillary dysentery was stated by the director of the Japanese Government Institute for Infectious Diseases to be mainly of four types: Komagome strains A and B; Shiga which is increasing after constituting only 10 to 15 percent of the cases 5 years ago; and Ohara. The childrens' disease, Ekiri, has been given this name, meaning "epidemic diarrhea," in Japan and is not known to have been identified outside of Japan.

It is the observation of the director of the Japanese Government Institute for Infectious Diseases that Ekiri among the children in a home is often associated with dysentery among adult members of the same household. He associates it more specifically with the Ohara strain of bacillary dysentery. Records showing evidence of Ekiri as distinguished from other types of dysentery were secured from four cities. They show trends in case rates for Ekiri and other types of dysentery which approximate each other through the 4 years covered by this record except that the Ekiri rates for 1945 are low.

This is probably due to the reduction in the proportion of children in the populations of these cities as a result of evacuation (Figure 42). The smaller reductions in Kyoto's Ekiri rate as compared with that of the other three cities would support this theory since the evacuation from Kyoto was comparatively less extensive (10 percent as compared with 40 or more percent for the other three cities). Nagoya's Ekiri rate for the year 1945 shows a drop over 1944 but the Ekiri rate for the summer months of 1945 in this city does show a rise during the months of the dysentery epidemic (Figure 45). An extraordinarily low Ekiri rate for the rest of 1945 in Nagoya prevents this rise during the summer months from being reflected in the annual rate (Table 126).

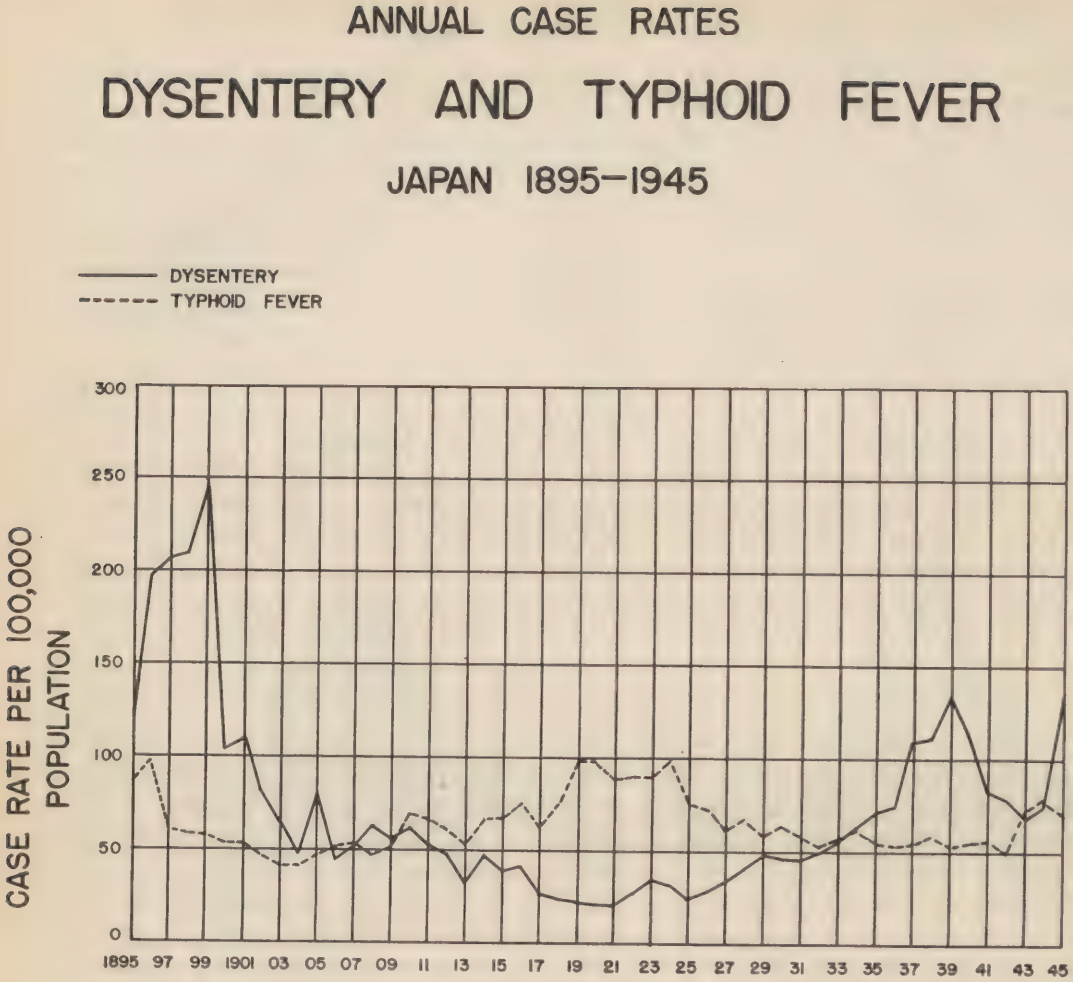


FIGURE 43

TABLE 126.—*Annual case rates for Ekiri and other types of dysentery in four Japanese cities from January 1941 through October 1945*

Year	Tokyo		Yokohama		Nagoya		Kyoto		Combined cities	
	Dysentery	Ekiri	Dysentery	Ekiri	Dysentery	Ekiri	Dysentery	Ekiri	Dysentery	Ekiri
1941	163.1	81.4	96.1	45.8	93.1	80.3	138.3	91.1	144.9	78.9
1942	141.2	77.6	80.5	41.6	89.7	105.3	104.9	97.5	124.7	79.9
1943	73.0	42.3	41.7	15.5	48.7	78.9	153.1	74.2	74.7	47.9
1944	46.4	24.7	40.8	14.7	44.2	57.0	78.0	35.0	48.6	29.3
1945	67.0	10.2	45.3	4.7	582.1	55.4	85.9	25.4	136.8	17.7

Study of records of monthly incidence of dysentery in the six cities covered by this study and in Japan proper for the years 1941 through 1945 indicates an outstanding incidence of dysentery in 1945 for Nagoya and for Japan as a whole (Figure 44). The outbreak in Nagoya began in July and extended into October with the peak occurring in August. The bombing record for Nagoya shows an extensive bombing with incendiary bombs in May and a comparatively heavy attacks with high-explosive bombs in June. It is reasonable to consider that these bombings were largely instrumental in producing the conditions which led to this outbreak.

The only other outstanding monthly rates for dysentery (Figure 44) are those for August and September for Japan as a whole. These high rates for 1945 indicate the occurrence during these summer months of some factors, other than those produced by the general war activity, which affected the entire population

BOMBING EXPERIENCE AND CASE INCIDENCE OF

TYPHOID AND PARATYPHOID FEVER AND DYSENTERY

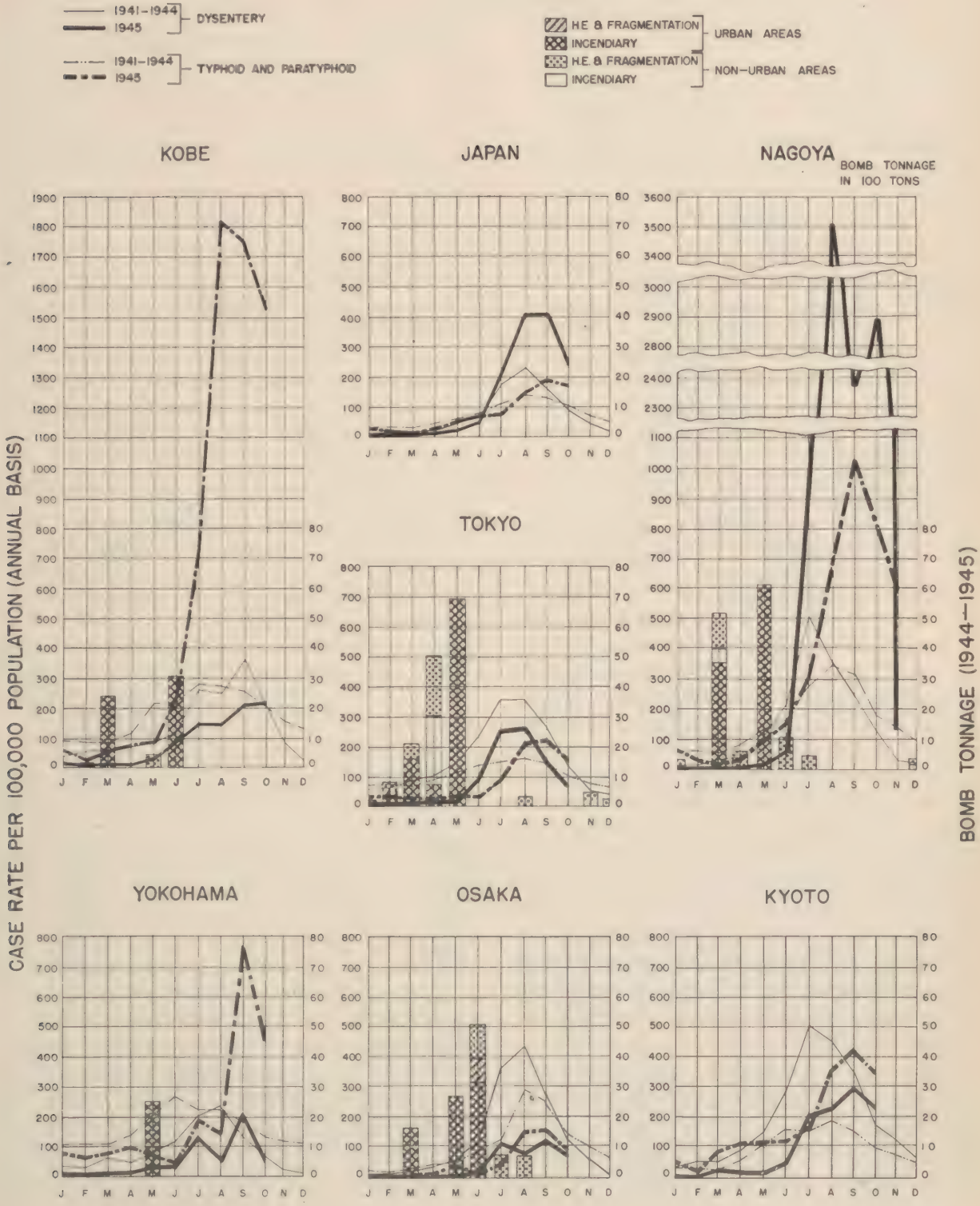


FIGURE 44

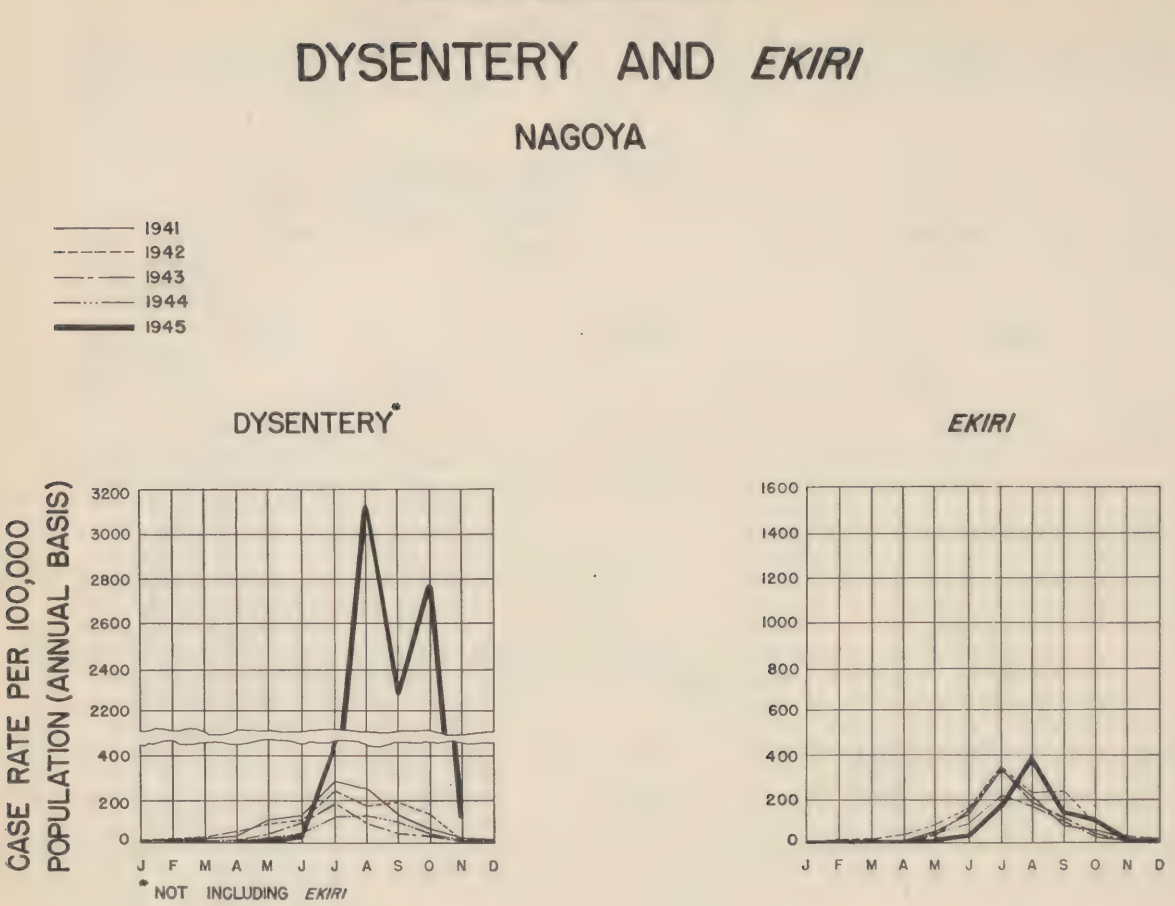


FIGURE 45

or, at least, large sectors of it. An outstanding factor which presents itself as possibly accountable for this increase is the effect of bombing on the population in the bombed areas, and more particularly in the impact of the population evacuated from the bombed areas upon the people in the areas receiving them. In an effort to measure the influence of this factor on the 1945 dysentery rate for Japan a comparison was made of the August 1945 dysentery case rate for each of the 10 different regions into which Japan is divided and the 1944 population of the bombed cities in those regions. These bombed cities are the 163 cities on which data is listed in Appendix C–1.

Unfortunately the data on which the dysentery rates for August 1945 are based are not complete but they are felt to provide an adequate indication of the distribution of the disease through the country. Together with these 1945 rates are shown the corresponding rates for August 1940 as an aid in finding where the 1945 rates were abnormally high. Such comparison indicates that the Tosan, Tokai, Chugoku, Shikoku and Kyushu regions were largely responsible for the country's high dysentery rates during August 1945. Study of the population of the bombed cities in these regions

TABLE 127.—*Comparison of dysentery case rates for August 1940 and August 1945 in nine regions comprising all Japan*

Region	August rates per 100,000 population		Population of bombed cities	Percent of total population
	1940	1945		
Hokkaido	31.4	17.7	751,354	2.68
Tohoku	93.4	24.9	900,084	3.21
Kanto	500.2	215.2	10,054,788	35.90
Hokuriku	31.9	45.1	648,362	2.31
Tosan	199.2	452.4	450,835	1.62
Tokai	225.8	572.9	2,823,410	10.08
Kinki	415.9	167.8	6,711,262	23.96
Chugoku	338.4	653.3	1,810,111	6.46
Shikoku	439.4	907.5	721,798	2.58
Kyushu	240.4	1,031.9	3,135,433	11.20
Total			28,007,437	100.00

indicates that they constituted only 32 percent of the population of the 163 bombed cities. The Tokai region includes Nagoya where the dysentery epidemic to which reference has already been made (Figure 44) may account to a certain extent for the high rate of 573 cases. The rate of 215 cases for the Kanto region in which Tokyo and Yokohama are located is considerably lower than the corresponding rate for 1940 as is also the rate of 168 cases for the Qinki region in which Osaka, Kyoto and Kobe are located. The poor correlation between the distribution of population of bombed cities and high dysentery rates indicates that evacuation from these cities, while they may have contributed to the high incidence of dysentery during the summer of 1945, were not the main factors involved. The high rates for the southern regions, Chugoku, Shikoku and Kyushu, which grow progressively higher as they move southward to Kyushu, suggests the possibility of a climatic factor though no substantiation has been found for this theory.

Turning from the dysenteries to typhoid and paratyphoid fever, an epidemic of this disease comparable to the dysentery epidemic in Nagoya is noted in the record of Kobe for the summer of 1945 (Figure 44). The rate began to rise in June, the month in which Kobe received its heaviest bombing, and reached its peak in August when the case rate was more than six times Kobe's average rate for August during the previous four years.

Others of the six large cities which showed a high typhoid and paratyphoid fever case rate during the summer of 1945 are Nagoya, Yokohama and Kyoto (Figure 44). In Nagoya the rise in case rate began in May, a month of very heavy bombing, but did not reach serious proportions until August. The peak rate in September of 1,034 cases per 100,000 persons per year was more than three times the average rate for September during the four previous years. It is of interest to note that this typhoid and paratyphoid fever epidemic in Nagoya covered the same period as the more severe dysentery epidemic in this city. This would suggest a common cause for the two epidemics, the dysentery epidemic reaching its peak in August and the typhoid and paratyphoid fever epidemic, with its longer incubation period, reaching its peak in September.

The peak of the typhoid and paratyphoid fever case rate for Yokohama of 455 cases per 100,000 persons per year was reported for September. This rate was more than three times the average rate for this month during the previous four years. While it did not immediately follow a severe bombing there is justification for associating it with conditions growing out of the earlier bombing in May, for unrepaired breaks still existed in the water mains and more particularly in the pipes which had carried water into the buildings destroyed in the air raids. Leakage from these breaks created pools from which backflow into the water system was produced whenever pressure in the main fell to a point which would permit such backflow, and low pressure areas frequently developed in the water mains due to difficulty in keeping the booster stations in operation. These breaks in the water systems resulting from air raids therefore constituted a potential source for the spread of water-borne disease until they were repaired, and in Yokohama very little progress had been made in repairing them up to the time of the typhoid and paratyphoid outbreaks. It is reasonable therefore to consider that these conditions produced by the air raids in May combined with the warmer temperatures of the summer months may have been a causative factor in producing the outbreak of typhoid and paratyphoid fever in Yokohama during this period.

The Kyoto typhoid and paratyphoid fever epidemic during August, September and October was not directly associated with bombing since this city was not severely bombed. It may however be associated with defective water treatment devices, shortages and inferior qualities of chemicals and materials used in these treatment processes. Such shortages and defects are known to have existed in Kyoto.

We have noted increased incidence of typhoid and paratyphoid fever during the bombing period in four of the six cities covered by this study. The fact that one of these four cities was Kyoto, which was not bombed, points to the possibility of causal factors other than bombing being operative in the other three cities also. However in spite of this possibility, conditions produced by bombing seem to be closely associated with the outbreaks in these cities.

It is not known to what extent findings among these six cities on incidence of typhoid and paratyphoid fever are typical of the entire country but the increased rate shown for Japan as a whole during this same period (Figure 44) suggests the possibility that similar high rates also prevailed in many other cities.

When conditions, as reflected in the incidence of these enteric diseases during the bombing period in Japan, are compared with similar conditions in Germany during their bombing period, an outstanding observation is the very much higher incidence of these diseases in Japan than in Germany. The combined dysentery rates for six surveyed German cities during five years immediately before and during the bombing period ranged from 13 to 27 cases per 100,000 persons per year. A comparable record for the six Japanese cities ranged from 74 to 204 cases per 100,000 persons per year. A similar comparison on incidence of typhoid and paratyphoid fever shows German rates ranging from 7 to 11 cases per 100,000 persons per year compared with Japanese rates varying from 72 to 185 cases per 100,000 persons per year.

This indicates the very high incidence of these enteric diseases in Japan as compared with their place in the communicable disease picture of Germany. Dysentery epidemics with peak monthly rates such as that of Nagoya for June 1945 of 3,500 cases per 100,000 persons per year were unheard of in Germany. The peak monthly dysentery rate noted in the course of the survey of nine German cities was approximately 250 cases per 100,000 persons per year for the city of Duisburg.

Similarly the report of bombing in Germany shows no record of a typhoid fever epidemic comparable to that of Kobe in the summer of 1945 with its peak rate during August of 1,827 cases per 100,000 persons per year. Several outbreaks are reported for the nine German cities covered by the Survey but none of them exceed a rate of 120 cases per 100,000 persons per year.

It seems apparent therefore that the greater prevalence of dysentery and typhoid and paratyphoid fever in Japan made these diseases a much more dangerous potential source of epidemics than they were in Germany and actual outbreaks of these diseases where noted were also considerably more severe than in Germany.

Diphtheria

During the five years covered by this study the case incidence of diphtheria was very high and showed a tendency to rapidly increase in each of the six cities observed and in Japan as a whole.

TABLE 128.—*Annual case and death rates for diphtheria in the six largest Japanese cities and in all Japan from January 1941 through October 1945*

Year	Tokyo	Osaka	Yokohama	Kobe	Nagoya	Kyoto	Combined cities	All Japan
	Number of cases per 100,000 population per year							
1941	103.2	63.9	105.7	85.2	84.9	124.5	93.4	56.8
1942	138.2	68.7	121.7	88.4	148.6	102.6	117.1	62.8
1943	182.2	89.9	124.3	117.0	291.0	144.0	162.3	86.2
1944	204.2	97.1	162.8	166.6	529.2	210.4	211.2	128.4
1945	97.4	142.0	131.7	171.0	631.1	259.3	183.7	124.7
	Number of deaths per 100,000 population per year							
1941	8.8	4.6	(1)	11.4	13.4	13.5	8.9	(1)
1942	11.1	5.7	(1)	7.1	14.8	8.7	9.8	(1)
1943	11.6	8.0	(1)	14.0	23.4	7.1	11.9	(1)
1944	10.4	10.6	(1)	10.5	24.6	12.6	12.3	(1)
1945	8.4	22.3	(1)	26.6	59.5	42.2	21.6	(1)

(1) No report.

This high and rising diphtheria case rate prevailed rather generally throughout Japan and was a cause of considerable concern among Japanese health authorities. The 1945 rate of 125 cases per 100,000 persons for all Japan is nine times the corresponding 1945 rate of 14 cases per 100,000 persons for the United States. The rise is rather constant through the past 25 years with a pronounced acceleration in 1943 and 1944 (Figure 46). This acceleration may be associated with war conditions during these years but does not indicate any special effect of bombing.

It is of interest to note that during 1943 and 1944 there was also a pronounced increase in the incidence of diphtheria in northern Europe. Norway reported cases which totaled 24 times the prewar level (median 1928–38); the Netherlands, 14 times; Belgium, 8 times; Sweden, 4 times; Germany, 3 times; and France and Switzerland, each, 2 times. These reports all represent totals of cases for 1943 except those for Sweden and Switzerland for which they refer to 1944.

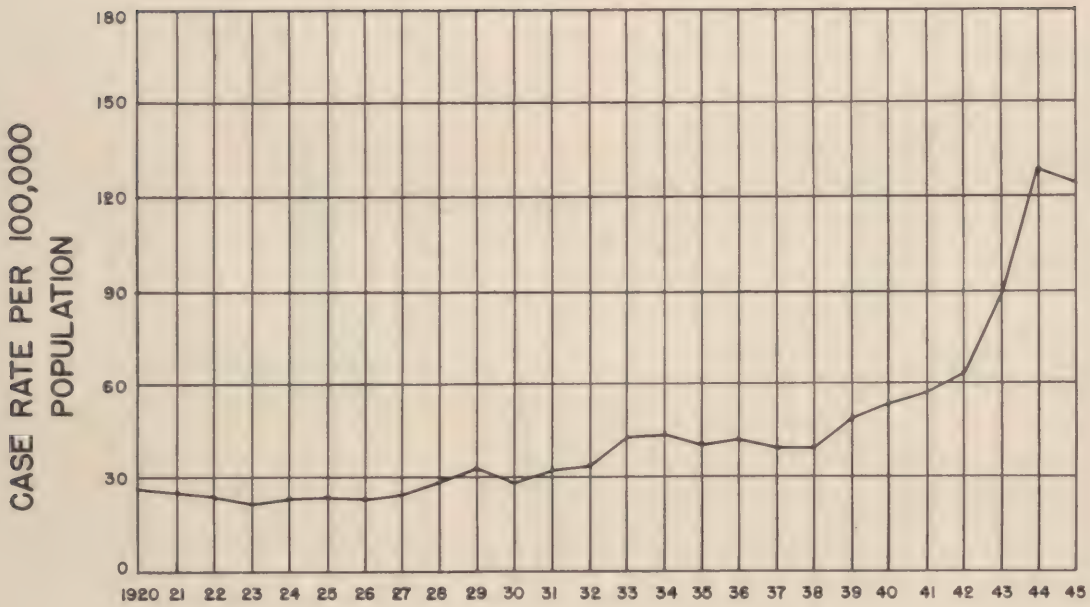


FIGURE 46

In considering the 1945 diphtheria case and death rates in the large cities it is to be noted that since diphtheria is primarily a children's disease, reduction in the proportion of children in these cities (Figure 42) would tend to depress these rates even though the actual number of cases in relation to the number of children is not decreased. On this account the 1945 case and death rates for the large cities (Table 128) must be considered to be conservative.

Shortage of diphtheria toxoid may be accountable at least in part for failure of Japanese authorities to lay greater emphasis on preventive measures against this disease. Prior to the war, immunization against diphtheria was required for school children but no preventive measures were taken among preschool children or adults; no record has been found of any change in the regulations during the war period.

Study of monthly diphtheria case rates for 1945 in comparison with corresponding rates for the previous 4 years in the six largest cities of Japan and in Japan as a whole showed outstanding rates for Yokohama, Nagoya, Osaka and for all Japan (Figure 47). In most cases, however, these 1945 rates represented increases over the 1944 rates which were comparable to the increase of the 1944 rates over those for 1943. These 1945 rates therefore represent the normal trend in diphtheria incidence for these cities and so cannot readily be attributed to bombing. Another factor which tends to indicate that the high rates were not related to bombing is the fact that they occurred in months previous to the more severe bombing. Kyoto, which escaped bombing, also showed a more pronounced increase in diphtheria during the air attacks than any other of the six cities studied.

All these factors tend to indicate little, if any,

BOMBING EXPERIENCE AND CASE INCIDENCE OF DIPHTHERIA

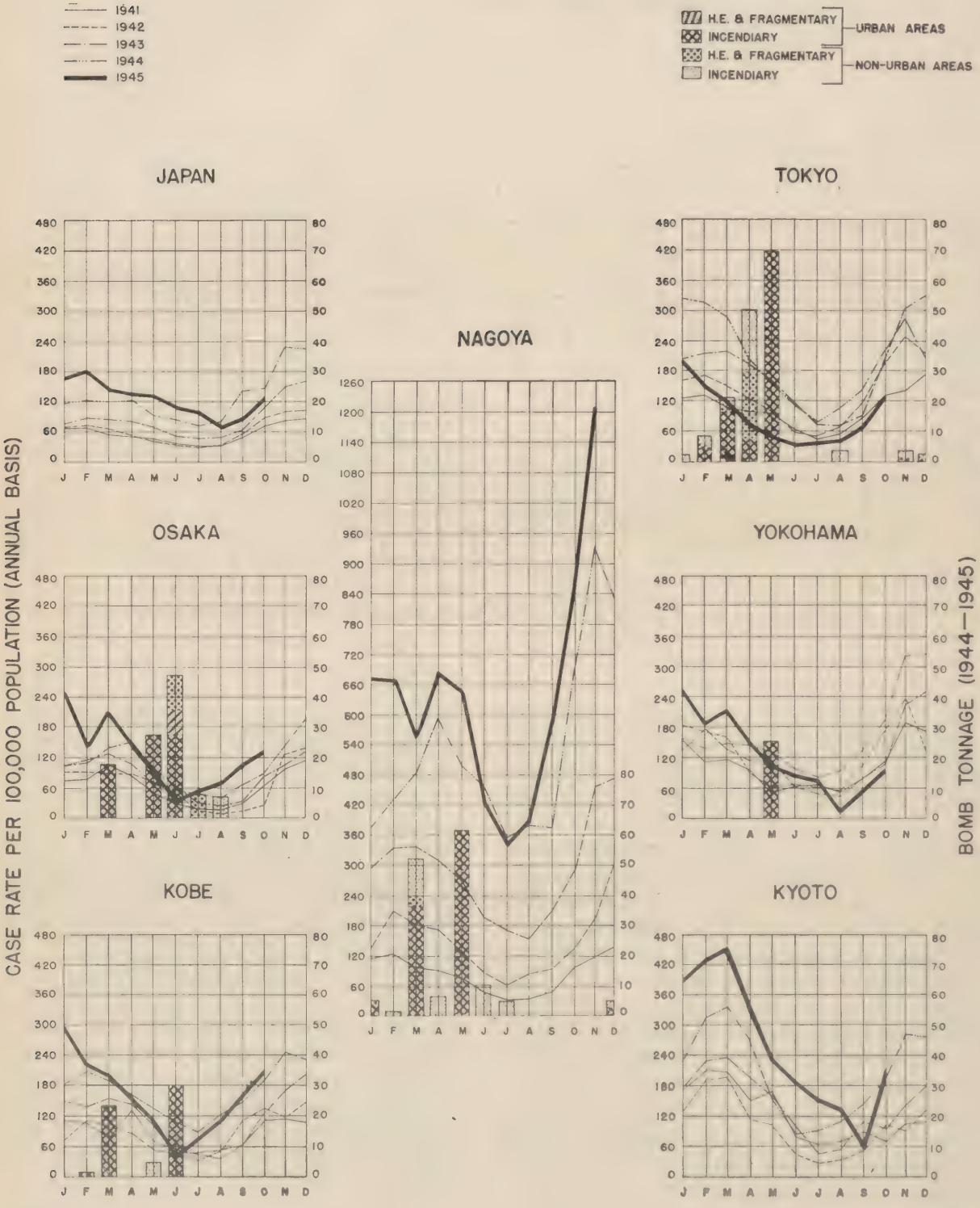


FIGURE 47

relationship between bombing and incidence of diphtheria in the six largest cities of Japan. The record of diphtheria cases for all Japan also fails to show any definite evidence of an increase in this disease as a result of bombing.

Meningococcus Meningitis

Case and death rates for meningoccoccus meningitis for the years 1941 through 1944 in the six largest Japanese cities and for Japan as a whole do not show any marked variation.

TABLE 129.—*Annual case and death rates for meningococcus meningitis in the 6 largest Japanese cities and in all Japan from January 1941 through October 1945*

Year	Tokyo	Osaka	Yokohama	Kobe	Nagoya	Kyoto	Combined cities	All Japan
Number of cases per 100,000 population per year								
1941	1.7	2.5	1.4	1.9	1.2	3.3	2.0	1.7
1942	1.9	1.5	1.1	2.1	.7	2.1	1.7	1.2
1943	1.4	1.9	.9	1.6	1.1	3.2	1.6	1.5
1944	1.5	1.8	1.6	1.1	1.0	1.6	1.5	2.0
1945	2.3	2.0	4.8	3.8	2.6	6.3	3.0	6.5
Number of deaths per 100,000 population per year								
1941	0.69	0.35	(1)	1.22	0.52	1.65	0.71	(1)
1942	.71	.38	(1)	.93	.44	.91	.64	(1)
1943	.57	.57	(1)	.85	.57	.77	.61	(1)
1944	.41	.67	(1)	.45	.22	.74	.48	(1)
1945	.57	.71	(1)	1.05	.98	2.56	.89	(1)

[1] No report.

However, the corresponding records for 1945 are consistently higher than those for the previous four years, and in the case of Yokohama, Kobe, Kyoto and for all Japan the 1945 case rate is more than three times the corresponding rate for 1944. These case rates are also considerably higher than corresponding rates reported for bombed German cities. The highest rate reported for seven surveyed German cities was that for Bochum in 1942 of 1.9 cases per 100,000 persons as compared with the 1945 rate for Kyoto of 6.3 cases per 100,000 persons per year.

It is of interest in this connection to note that the seven surveyed German cities showed little or no increase in incidence of meningitis during their bombing period. The combined rates for the seven cities were 0.33, 0.46 and 0.39 cases per 100,000 persons during 1942, 1943 and 1944, the years of the bombing period.

Examination of the monthly case rates corresponding to the annual rates shown in Table 129 indicate that the high annual rates for Yokohama, for all Japan and to a certain extent for Kyoto are associated with increased case rates during the early months of 1945, while for Kobe the high annual rate is the result of a more sustained high incidence during the first half of the year (Figure 48). The records for Tokyo and Nagoya also show rates for the 2-month periods of February and March and March and April, respectively, in 1945 which exceed rates for these months in any of the previous four years.

Little, if any, direct relationship can be established, however, between bombing and this increased incidence of meningitis. Yokohama was severely bombed and also experienced a serious outbreak of meningitis but the meningitis preceded the bombing by several months. Kyoto, which reported a high incidence of meningitis during March, April and May, was not severely bombed at any time. For Tokyo and Nagoya where high incidence of meningitis might possibly be associated with bombing, the rates for the bombing period, while high, are not outstanding.

Indications are, therefore, that the high meningitis rates, while not directly associated with bombing, are associated with the crowding of populations which was an effect of bombing. This would account for its higher incidence in the cities under observation during the earlier months of the year when the population had been disturbed as a result of bombing but before extensive evacuation had taken place. However, it is to be remembered in this connection that these months of higher incidence are months during which seasonal incidence of meningitis is normally high and the increased rates during this period therefore cannot be attributed too strictly to conditions produced by bombing.

The period of high incidence of meningitis for Japan as a whole occurred in March and April and it is likely that this reflects conditions in cities throughout Japan similar to those found in the cities studied. Reasonably complete records are available on the incidence of meningitis in each prefecture during the first six months of 1945. Study of these records indicates that 23 of the 46 prefectures had meningitis case rates during this period which were three or more times as great as their rates for the corresponding months of 1940 (Table 130). Rates for these 23 prefectures range as high as

BOMBING EXPERIENCE AND CASE INCIDENCE OF MENINGOCOCCUS MENINGITIS

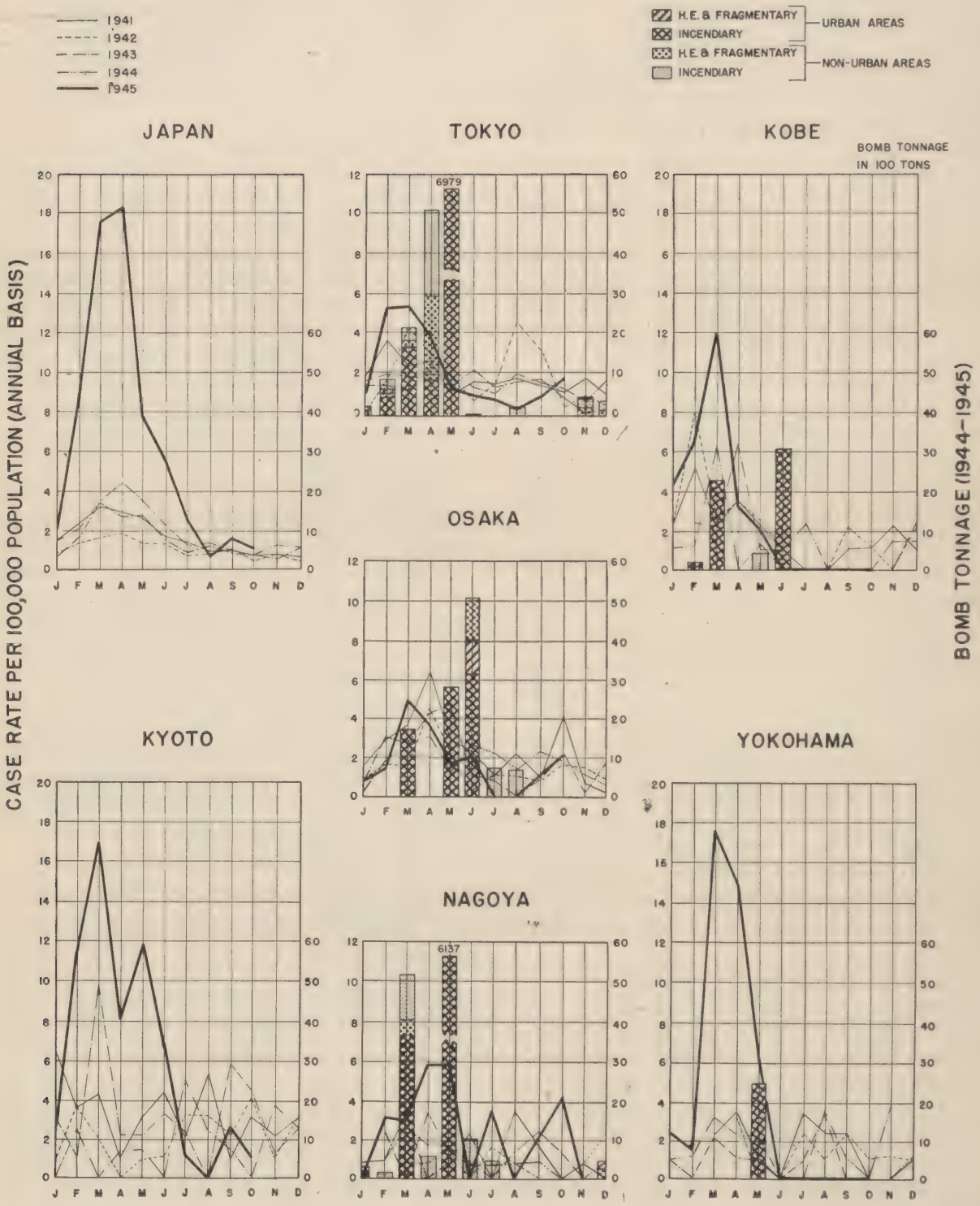


FIGURE 48

49 cases per 100,000 persons per year. This rate is shown for Fukuoka prefecture where Moji, one of the ports of the Shiminoseki Straits, is located. It is of interest that 14 of the 23 prefectures listed in Table 130 fall into two groups, one group of 9 clustering around Tokyo and Yokohama and a second group of 5 centering in the Osaka-Kobe-Kyoto area. Population disturbances resulting from evacuation of these and other neighboring cities and crowding of areas receiving these refugees are very probably accountable at least in part for this situation.

TABLE 130.—*Meningococcus meningitis case rates for the first six months of 1940 and 1945 for prefectures for which the 1945 rate is 3 or more times that for 1940*

Prefecture	Cases per 100,000 population (annual basis)		Ratio of 1945 to 1940 rate	Total cases	
	1940	1945		1940	1945
1. Hokkaido	10.69	70.90	6.63	174	1,237
2. Miyagi	2.85	25.39	8.91	18	184
3. Fukushima	1.36	11.13	8.18	11	108
4. Ibaraki	3.35	15.97	4.77	27	154
5. Tachigi	.33	1.70	5.15	2	13
6. Gumma	1.08	6.65	6.16	7	51
7. Saitama	.13	.89	6.85	1	9
8. Chiba	.25	1.23	4.92	2	12
9. Kanagawa	.73	14.70	20.14	8	136
10. Niigata	.10	1.35	13.50	1	16
11. Nagano	.35	1.24	3.54	3	13
12. Mei	.50	3.04	6.08	3	21
13. Shiga	.86	3.28	3.81	3	14
14. Kyoto	1.51	11.94	7.91	13	95
15. Hyogo	1.00	4.22	4.22	16	59
16. Wakayama	.46	2.59	5.63	2	12
17. Tottori	2.08	6.80	3.27	5	19
18. Yamaguchi	.78	23.49	30.12	5	158
19. Kagawa	.28	3.97	14.18	1	17
20. Fukuoka	8.25	49.48	6.00	127	674
21. Kumamoto	.44	2.85	6.48	3	22
22. Nagasaki	.48	4.63	9.65	2	21
23. Kagoshima	.63	2.75	4.37	5	21

Scarlet Fever

The scarlet fever case rate for all Japan increased gradually from 0.2 cases per 100,000 persons in 1900 to a peak of 27.3 cases per 100,000 persons in 1939. Since 1939 the rate decreased rapidly until in 1945 it has dropped to 3.4 cases per 100,000 persons (Table 131). This rapid decline also characterized the records of the six largest cities from 1941 through 1945 on both case and death rates with a very pronounced drop in the 1945 case rates from those for 1944. This accelerated drop in 1945 may be accounted for in part at least by the decrease in the proportion of children in the population of these cities following the evacuations during the bombing period (Figure 42).

The comparatively higher 1945 rate for

TABLE 131.—*Annual case and death rates for scarlet fever in the 6 largest Japanese cities and in all Japan from January 1941 through October 1945*

Year	Tokyo	Osaka	Yokohama	Koba	Nagoya	Kyoto	Combined cities	All Japan
	Number of cases per 100,000 persons per year							
1941	82.3	14.5	78.1	31.9	34.7	58.6	57.4	21.0
1942	70.6	19.8	43.0	27.9	38.9	51.1	50.4	17.9
1943	54.3	16.2	36.7	24.8	32.0	29.9	39.1	13.7
1944	26.9	8.5	22.8	10.3	21.1	28.8	21.3	8.7
1945	7.7	2.9	5.5	5.9	9.6	13.2	7.3	3.4
	Number of deaths per 100,000 persons per year							
1941	0.97	0.32	(1)	0.61	0.67	1.00	0.76	(1)
1942	.67	.29	(1)	.52	.94	1.91	.70	(1)
1943	.50	.16	(1)	.53	.43	.19	.39	(1)
1944	.30	.15	(1)	.11	.15	.32	.24	(1)
1945	.16	.08	(1)	.63	.51	.23	.23	(1)

[1] No report.

Kyoto would, on this basis, be accounted for by the fact that the population was less affected by these migrations than were the populations of the other surveyed cities. To the extent that this decrease in the proportion of children in the population of the surveyed cities is responsible for the reduction in rates noted, it does not indicate an actual reduction in incidence among the children remaining in the cities. It is probable that there was an actual reduction as is indicated by the decreasing rate for Japan as a whole but that it was less pronounced than is indicated by the 1945 rates shown for the various cities in Table 131.

The case rate of 3.4 cases per 100,000 persons for all Japan contrasts rather markedly with the corresponding 1945 rate for the United States of 129 cases per 100,000 persons. The corresponding rates for seven bombed cities in Germany were 201 and 256 for 1938 and 1939 prior to the bombing period and 653, 505 and 342 for 1942, 1943 and 1944 during the bombing period. The higher rates during the bombing period in Germany were associated with an epidemic which reached its peak in 1941 and were not associated with bombing. The significant feature of these rates is that they are about ten times as high as the corresponding Japanese rates for her six largest cities.

Study of the monthly scarlet fever case rates, supporting the annual rates shown in Table 131, shows no marked variation in the incidence of this disease during 1945 in any of the six largest cities or in Japan as a whole (Figure 49). The greatest variation in monthly inci-

dence during 1945 is shown for Kyoto which was never severely bombed.

These rates indicate clearly that Japan had a low and decreasing scarlet fever case rate during the period from 1941 through 1945 and that there is no evidence of increase in the incidence of this disease during the bombing period.

Smallpox

The number of cases of smallpox showed a slight tendency to increase in 1945 in the six largest cities of Japan and in Japan as a whole. This trend was supported by death rates for the five cities for which this information was available. In no instance, however, did the increase approach anything like epidemic proportions. The most pronounced increase was in Kobe which showed a rise from no cases in 1944 to 8.6 cases per 100,000 persons in 1945. This increase was due to an outbreak of smallpox in August, September and October 1945 in the course of which 40 of the 41 cases reported for the year occurred. The city reporting the next highest rate was Nagoya with a rate of 4.3 cases per 100,000 persons. This rate represents 34 cases. Twenty-six of these cases occurred in July, August and September with a peak of 13 in August. These two outbreaks are mainly responsible for the high incidence of smallpox shown for the six largest Japanese cities during the latter half of 1945 (Figure 50). It will be noted that this high rate during these summer and fall months differs from the picture for these same cities during the previous 4 years as shown in Figure 50, and also from the monthly rates for Japan as a whole in 1945.

TABLE 132.—*Annual case and death rate for smallpox in the 6 largest Japanese cities and in all Japan from January 1941 through October 1945*

Year	Tokyo	Osaka	Yokohama	Kobe	Nagoya	Kyoto	Combined cities	All Japan
Number of cases per 100,000 persons per year								
1941	0.25	1.45	0.57	0.10	0.07	0	0.49	0.91
1941	.52	.03	.20	0	.29	0	.30	.54
1943	.54	.40	.29	.64	.07	.10	.42	.81
1944	.21	.15	0	0	.87	0	.22	.44
1945	.60	.94	0.96	8.60	4.32	.13	1.53	1.91
Number of deaths per 100,000 persons per year								
1941	0	0.06	(1)	0	0	0	0.01	(1)
1942	.07	0	(1)	0	.07	0	.04	(1)
1943	.06	.17	(1)	.11	.07	0	.08	(1)
1944	.02	.04	(1)	0	.29	0	.05	(1)
1945	0	.24	(1)	1.68	.51	.13	.23	(1)

[1] No report.

The outbreaks of smallpox in these two cities in seasons when the incidence of smallpox is ordinarily low may be associated with the dislocation of population and other abnormal living conditions following bombing which interfered with the normal operation of health facilities. It is, however, to be noted that the smallpox case rate for these cities during the actual bombing period is extraordinarily low.

The case rate for all Japan was high during February, March, April and May, rose to a peak in June, and then subsided during the summer months (Figure 50). This would indicate a possible connection with bombing, but a check of prefectural data on smallpox cases indicates that one quarter of the cases reported for the country as a whole were reported from Hokkaido and another quarter was reported from Akita and Fukushima prefectures. These cases account largely for the rise in the case rate for the country as a whole to 1.9 cases per 100,000 persons during 1945. Hokkaido is the northern island which suffered very little bombing and Akita and Fukushima prefectures are in the northern part of the main island where bombing was relatively light.

Therefore, while there is evidence of some increase in incidence of smallpox during 1945 it is apparently associated with the general conditions inimical to health which increased as the war continued and was only indirectly related to bombing.

Typhus

Records on typhus in Japan do not distinguish between epidemic or louse-borne and murine or flea-borne typhus. However, it is believed that most of the cases shown in reports of recent years are murine typhus.

Prior to the war, typhus had almost disappeared in Japan. In 1938 there were no cases reported in any part of the country; in 1939 there were five; and in 1940, there were three cases. However, with the crowding and insanitary conditions resulting from the war, the number of cases increased rapidly during the years 1941 through 1945.

This increased incidence is reflected in the typhus rates for all Japan and for each of the

BOMBING EXPERIENCE AND CASE INCIDENCE OF

SCARLET FEVER

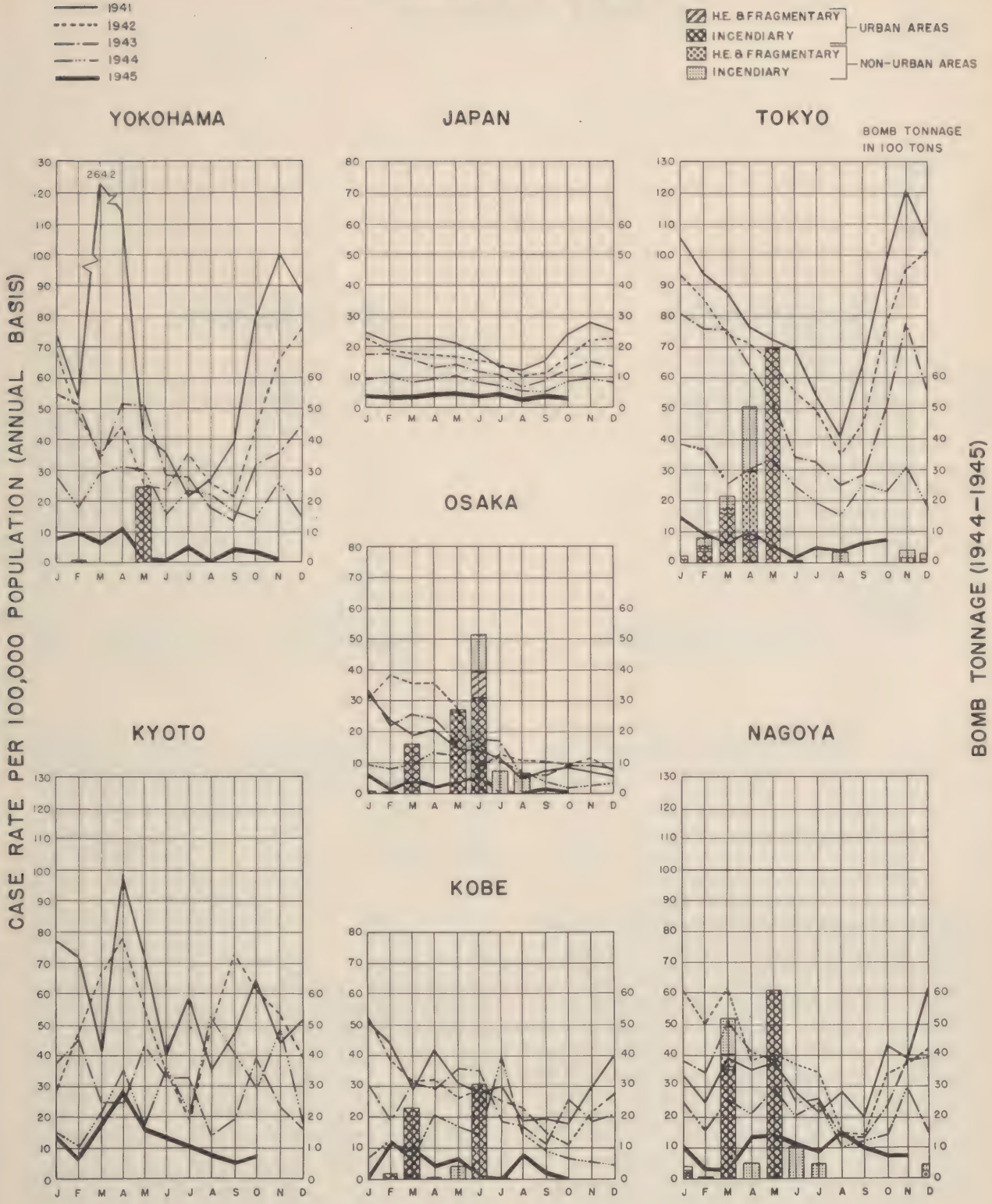


FIGURE 49

CASE INCIDENCE OF

SMALLPOX

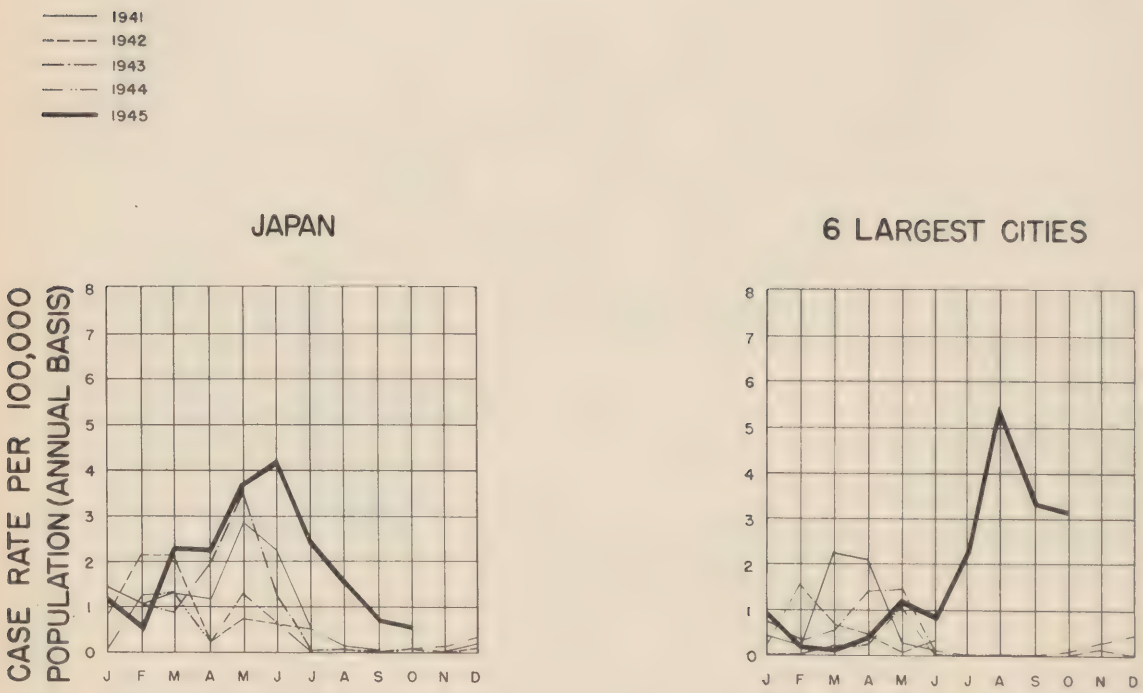


FIGURE 50

TABLE 133.—*Number of typhus cases reported in Japan*

Year	Number of cases
1941	87
1942	100
1943	1,407
1944	3,964
1945 (through October)	1,855

six largest cities (Table 134). Prefectural reports for 1945 show more than half of the cases for that year to be in the northern island of Hokkaido with an additional outbreak of some 400 cases in Fukuoka prefecture south of the Shimonoseki Straits. Among the six largest cities, Tokyo and Yokohama show the highest rates in 1944 with Yokohama and Kobe standing foremost in 1945. Kobe shows its peak rate in 1945.

Study of monthly trends in 1945 shows peak rates for all Japan and for the six largest cities to have been reached in May (Figure 51). This would suggest the possibility of correlation with

TABLE 134.—*Annual case and death rate for typhus in the six largest Japanese cities and in all Japan from January 1941 through October 1945*

Year	Tokyo	Osaka	Yokohama	Kobe	Nagoya	Kyoto	Combined cities	All Japan
Number of cases per 100,000 persons per year								
1941	0.29	0	0	0.20	0	0	0.15	0.12
1942	.33	0	0	.10	.22	0	.19	.14
1943	.87	.07	.10	2.99	.07	.19	.66	1.94
1944	10.62	2.21	3.89	1.03	.07	0	5.91	5.43
1945	.70	0	2.41	3.99	.64	0	.86	3.09
Number of deaths per 100,000 persons per year								
1941	0.04	0	(1)	0	0	0	0.02	(1)
1942	.09	0	(1)	.10	0	0	.05	(1)
1943	.10	0	(1)	.64	0	0	.10	(1)
1944	2.96	.11	(1)	.46	0	0	1.59	(1)
1945	0	0	(1)	1.05	0	0	.07	(1)

[1] No report.

bombing which also reached its peak during this period. However, during 1944 the highest rates for the six largest cities were also reported for May and in 1943 a peak was reached

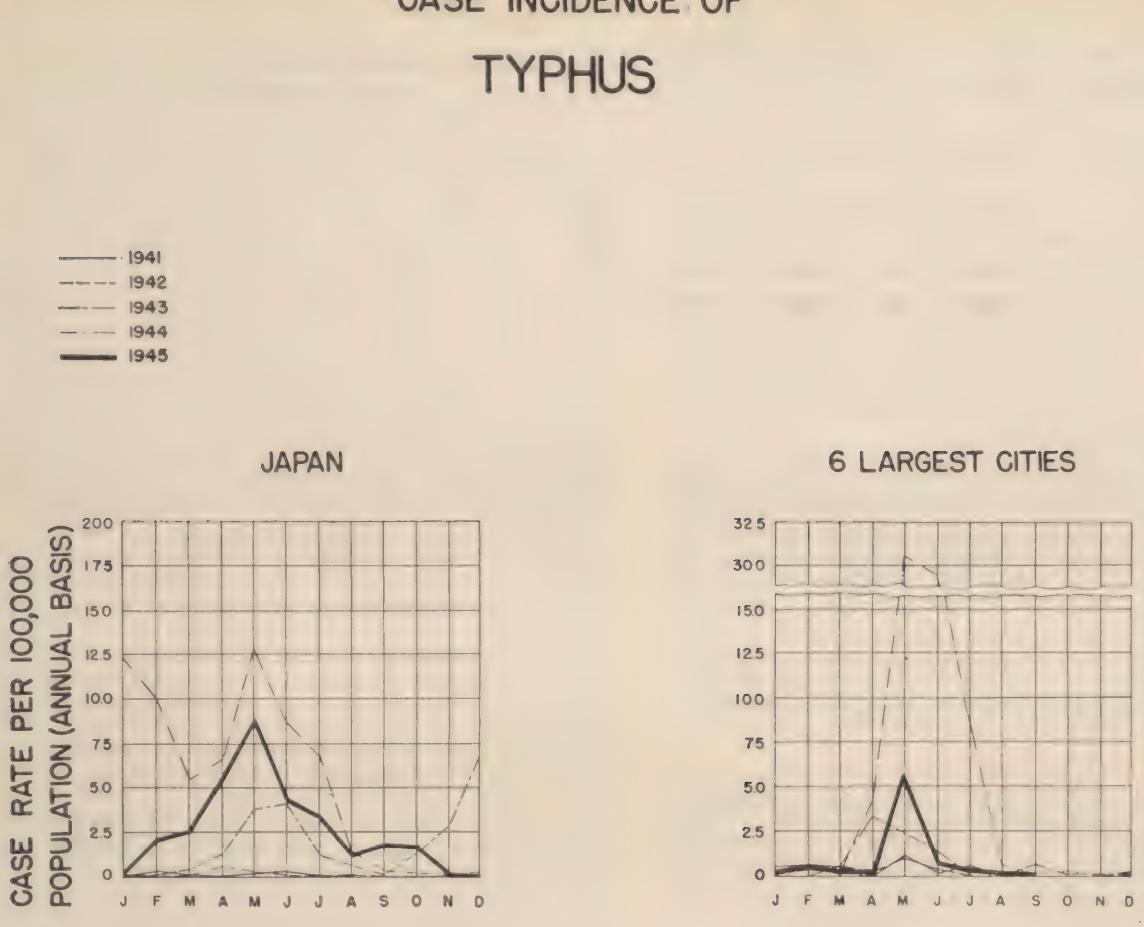


FIGURE 51

in April indicating that there are apparently factors other than bombing which tend to increase the typhus rate during these spring months. This theory is also supported by high rates for all Japan reported for May in 1944 and 1945. The May peak for all Japan in 1945 might be thought to be associated with bombing were it not that it was produced chiefly by cases occurring in the northern island of Hokkaido, which was not severely bombed. Groups affected here were chiefly miners, longshoremen and railroad gangs. Many of the persons making up these groups were workers imported from Manchuria and Korea. These observations indicate that war conditions produced increased incidence of typhus in the cities studied and in Japan as a whole but that bombing as a separate factor did not have a prominent part in bringing about the increase.

Study of the incidence of typhus in Germany during the bombing period there shows that in seven bombed cities this disease increased from no cases in 1940 to 5.5 per 100,000 population in 1944. In 1942, the first year of bombing, two of the seven cities reported cases with the rate for seven cities averaging 0.23 cases per 100,000 persons. In 1943 six of the seven cities reported cases with an average rate for the seven cities of 0.65 cases per 100,000 persons. In 1944 only five cities continued to report cases but three of them reported considerably higher incidence, raising the average rate for the seven cities to 5.5 cases per 100,000 persons. It is generally believed that the increased incidence of typhus in Germany during the war is attributable to the influx of foreign workers from those eastern countries where this disease is endemic. During the earlier years of the war these workers were segregated in labor camps but the breaking down of the line of demarcation between forced laborers and German citizens caused by the air raids was responsible for the spread of typhus to the civilian population. This indicates a situation similar in general to that found in Japan

where the increased incidence of typhus is believed to be traceable to the labor groups in mines and port cities and in railway labor gangs, largely in Hokkaido.

CASE FATALITY RATES

The effect of bombing in the field of communicable disease is felt mainly in increased incidence. However, conditions resulting from bombing such as shortage of personnel, facilities and drugs for treatment of illness may cause a proportionate increase in deaths which would greatly accentuate the sense of disaster produced by bombing.

The case and death records of the various notifiable diseases for Tokyo, Osaka, Nagoya, Kobe and Kyoto have been examined to find the proportion of cases which terminated fatally during the bombing period and during the previous four years. This examination has indicated what, if any, changes have taken place in case fatality rates during the bombing period.

Dysentery

Study of these rates for dysentery indicates that the number of deaths per 100 cases for this disease did not vary greatly in 1945 from that for the previous 4 years.

TABLE 135.—*Number of deaths per 100 cases of dysentery*

Year	Tokyo	Osaka	Kobe	Nagoya	Kyoto	Combined cities
1941	16.9	18.1	20.0	13.4	16.6	18.5
1942	16.1	15.5	15.5	33.8	18.5	17.7
1943	13.0	16.3	20.8	39.1	6.6	16.3
1944	16.7	12.3	18.5	35.3	14.6	18.9
1945	15.3	7.9	21.5	19.6	20.9	18.2

The most marked increase in this rate is noted for Kyoto which was not extensively bombed, while three of the four bombed cities studied show rates for 1945 which are less than those for 1944. There does not seem to be any evidence in these rates, therefore, that conditions produced by bombing affected the treatment of dysentery in a way that led to higher death rates for this disease.

Typhoid and Paratyphoid Fever

Similarly case fatality rates for typhoid and paratyphoid fever for the same period show no special variation in 1945 from rates in the previous 4 years.

TABLE 136.—*Number of deaths per 100 cases of typhoid and paratyphoid fever*

Year	Tokyo	Osaka	Kobe	Nagoya	Kyoto	Combined cities
1941	12.9	12.0	18.5	13.8	11.0	13.6
1942	11.6	18.0	18.0	13.2	13.2	12.3
1943	8.1	12.8	14.7	12.3	8.6	10.4
1944	6.5	15.2	19.5	14.4	16.2	11.4
1945	7.9	11.8	13.4	17.1	21.3	13.8

The most pronounced increase in the 1945 fatality rate is again shown for Kyoto with the rates for two of the other cities showing a decrease from 1944, and the rates for the other two showing a slight increase. No special significance as to the effect of bombing seems to be attachable to these variations.

Diphtheria, Scarlet Fever and Ekiri

The case fatality rates for the five surveyed cities for diphtheria show a consistently downward trend with only a few variations from 1941 through 1944 followed by a pronounced rise in 1945 (Table 137). Corresponding rates for seven German cities, studied in the survey of Germany, show a rise from 4.8 deaths per 100 cases in 1942 to 6.0 in 1943 and 7.1 in 1944. This indicates a rise in the diphtheria case fatality rate in Germany during the period of strategic bombing, which is comparable to that of Japan, though less pronounced.

TABLE 137.—*Number of deaths per 100 cases of diphtheria*

Year	Tokyo	Osaka	Kobe	Nagoya	Kyoto	Combined cities
1941	8.5	8.9	13.3	15.8	10.8	9.6
1942	8.0	12.8	8.0	10.0	8.5	8.4
1943	6.3	9.6	12.0	8.0	4.9	7.2
1944	5.1	9.4	6.3	4.6	6.0	5.7
1945	8.6	11.8	15.5	9.4	16.2	11.5

Review of case fatality rates for the other seven diseases covered by this study indicates that scarlet fever was the only other disease which showed a rise in case fatality in 1945. Its case fatality rate is normally very low, ranging somewhere between one and two deaths per 100 cases. However, during 1945 the scarlet fever case fatality rates for each of the five surveyed cities was more than two deaths per 100 cases. For three of the cities it was between two and three deaths per 100 cases; for Nagoya

it rose to 5.2 from a very low rate of 0.7 in 1944 to 5.3 in 1945; and for Kobe it rose to 10.7 in 1945.

TABLE 138.—*Number of deaths per 100 cases of scarlet fever*

Year	Tokyo	Osaka	Kobe	Nagoya	Kyoto	Combined cities
1941	1.18	2.17	1.9	1.92	1.72	1.36
1942	.95	1.46	1.86	2.43	3.74	1.37
1943	.92	1.03	2.15	1.33	.64	1.00
1944	1.12	1.75	1.10	.69	1.10	1.08
1945	2.13	2.70	10.71	5.26	2.04	3.07

The fact that diphtheria and scarlet fever are diseases more peculiar to children than the other six included in this study suggests that this might be a factor in the increased case fatality rate.

Corresponding case fatality rates are available for another children's disease, Ekiri, in Tokyo, Nagoya and Kyoto.

TABLE 139.—*Number of deaths per 100 cases of Ekiri*

Year	Tokyo	Nagoya	Kyoto	Combined cities
1941	34.6	56.7	31.8	37.4
1942	31.7	50.7	31.4	35.2
1943	24.0	55.7	10.3	29.2
1944	26.8	51.3	9.3	33.1
1945	36.1	55.5	35.6	44.5

They indicate increases in the 1945 rates which, while not as outstanding as those already noted for diphtheria and scarlet fever, are appreciable and tend to confirm the thesis that the 1945 increase in case fatality for diphtheria and scarlet fever was associated with the fact that they are predominantly children's diseases.

There was a tendency among Japanese authorities to give increased malnutrition as a cause of increased case fatality rates for 1945. To the extent that the effects of malnutrition are more pronounced among children, these findings, of increased case fatality rates for the children's diseases, suggest malnutrition as a possible cause.

For diphtheria, another possible cause for the rise in the case fatality rate was a shortage of diphtheria antitoxin. No definite information is available on this point but it is known that in July of 1943 a regulation was promulgated requiring that physicians submit a request identifying the case for which antitoxin was needed before they could secure the antitoxin. This suggests an effort to conserve antitoxin which would indicate a shortage or the fear of a shortage of this drug. Reports were also received indicating a tendency on the part of military authorities to commandeer for army use horses used in the preparation of antitoxin.

Even in the absence of an actual shortage of antitoxin, the effect of this regulation, making it more difficult for physicians to secure this drug, would be to introduce delay in its use and so help produce an increased diphtheria case fatality rate.

Meningitis, Smallpox and Typhus

Review of the case fatality rates for meningitis, smallpox and typhus indicates that the rates in 1945 were not higher than they were during the previous four years in the five cities in which they were studied.

TABLE 140.—*Case fatality rates for meningococcus meningitis, smallpox and typhus in Tokyo, Osaka, Kobe, Nagoya and Kyoto from January 1941 through October 1945*

Year	Meningococcus meningitis		Smallpox		Typhus	
	Deaths per 100 cases	Number of cases	Deaths per 100 cases	Number of cases	Deaths per 100 cases	Number of cases
1941	34.8	273	3.1	65	13.6	22
1942	36.4	236	14.6	41	25.9	27
1943	36.7	218	19.3	57	14.1	92
1944	31.5	184	20.7	29	26.2	241
1945	31.6	196	14.6	110	10.0	50

For meningitis the rate of 31.6 deaths per 100 cases was almost identical with that of the previous year of 31.5 and these rates were lower than those of the 3 years immediately preceding. For both smallpox and typhus the rates for the 5 years from 1941 through 1945 were quite variable because of the small number of cases on which they were based, but for smallpox the 1945 rate was next to the lowest shown for the 5-year period and for typhus it was the lowest.

Of the eight diseases under observation the only ones showing an increased case fatality rate during 1945, according to the records of Tokyo, Osaka, Kobe, Nagoya and Kyoto, were the two children's diseases, diphtheria and scarlet fever. Ekiri, also showed evidence of an increased 1945 fatality rate in three cities for which information on this disease was available.

SUMMARY

Review of reports on incidence of eight communicable diseases from the six largest cities of Japan and from Japan as a whole during the period from January 1941 through October 1945 indicates that dysentery, typhoid and paratyphoid fever were outstanding in reflecting the effects of strategic bombing. A severe epidemic of dysentery in Nagoya and a rather severe epidemic of typhoid and paratyphoid fever in Kobe were the most marked epidemics resulting from strategic bombing noted in the survey of the six cities. High incidence of typhoid and paratyphoid fever during the summer of 1945 were also noted in Nagoya, Yokohama and Kyoto. This high typhoid and paratyphoid fever case rate in four of the six cities studied and in Japan as a whole is taken to indicate the possibility that the high incidence of these diseases may have been associated with bombing in a number of Japanese cities. A high dysentery rate was also noted for Japan as a whole during the summer of 1945, but no satisfactory correlation could be established between bombing and areas of high incidence of this disease.

A number of examples were found of increased incidence of diphtheria, meningococcus meningitis, smallpox and typhus in the six surveyed cities during 1945, but they did not seem to be directly associated with bombing. For diphtheria, the increase in 1945 was not greater than a similar increase which was shown for 1944 and earlier years and it also preceded the bombing periods in most cities, indicating that bombing did not bear a direct causal relationship. The high meningitis rates showed evidence of being associated with crowding and so was indirectly related to bombing. The increased incidence of smallpox in no case approached epidemic proportions and was apparently related to the dislocation of population and abnormal living conditions which interfered with normal operation of health facilities. Typhus, which was, according to the records, very rare in Japan for several years before 1940, was thought to have been brought into Japan from Korea and Manchuria by imported laborers. Centers of high incidence of this disease in 1945 were Hokkaido (where many imported workers were employed in mines and ports) and Fukuoka prefecture in which Moji (a port of entrance from Korea) was located. The incidence of typhus in the surveyed cities, while comparatively high in 1945, was not outstanding and for three of the cities it represented a reduction from the corresponding rates for 1944.

Significant increases were found in case fatality rates during 1945 for diphtheria and scarlet fever. The fact that these two diseases were more peculiar to children than the other six diseases studied suggests that there might be a relationship between this and the increased case fatality rate. The more pronounced effects of malnutrition among children was suggested as a possible explanation of this correlation. Also a shortage of diphtheria antitoxin was possibly a factor in producing the increased case fatality rate for this disease.

VIII. GENERAL MORBIDITY

Air-raid casualties are of course the most direct and outstanding evidence of the effect of strategic bombing on the health of a population as measured in terms of illness and death. Next to air-raid casualties stand the effects of disease epidemics growing out of conditions produced by bombing. These two phases of the effect on health of strategic bombing have been given prior consideration.

BIRTH AND DEATH RATES PRIOR TO BOMBING

Beyond these more specific effects, however, are the broader and less tangible effects on the general population of illness and death from the usual and less dramatic causes. Satisfactory measures of these conditions are difficult to find. A standard source of such information on deaths is the official record of reported deaths within the general field of mortality. Infant and maternal mortality are generally given special attention as reflectors of health conditions and services in any study of the health of a population group.

In Japan war restrictions and peculiarities of the Japanese Statistical Bureau's methods of collecting mortality statistics combined to make this mortality information for the bombing period in 1945 entirely unavailable. Records of the Statistical Bureau were put under a close ban of secrecy during the war in order to suppress information on population. This together with the disturbance incident to removal of the Statistical Bureau's records from Tokyo and the scarcity of clerical assistance greatly retarded the preparation of mortality reports. The result was that no information was available on deaths during any part of 1945 at the time the data used in this survey were secured. Records from sample cities or areas also were not available because of the peculiar custom of the Japanese of reporting births and deaths to the authorities of the prefecture in which their ancestral home is located rather than in the prefecture of the present residence. It was therefore impossible to secure information on deaths in selected areas from local authorities because the information available from such sources referred to people who claimed the area as their ancestral home rather than their present residence.

The most recent year for which official mortality statistics were available from the Bureau of Statistics was 1942. However, an estimated rate for births, deaths and infant mortality was provided for 1943 by the Japanese National Institute of Health. Study of these rates together with corresponding rates for the preceding decade shows a steady decline in both the death rates for the general population and the infant mortality rate during the 10-year period, followed by a leveling off or a slight rise during 1942 and 1943.

TABLE 141.—*Japanese infant mortality deaths and birth rates, 1930–3*

Year	Infant deaths per 1,000 live births	Deaths per 1,000 population	Births per 1,000 population
1930	124.1	18.2	32.4
1931	131.5	19.0	32.2
1932	117.5	17.7	32.9
1933	121.3	17.8	31.6
1934	124.8	18.1	30.0
1935	106.7	16.8	31.6
1936	116.7	17.5	29.9
1937	105.4	16.9	30.6
1938	114.4	17.4	26.7
1939	106.0	17.4	26.1
1940	90.0	16.2	28.9
1941	84.1	15.5	30.8
1942	85.5	15.5	29.7
1943	86.6	16.0	29.8

The birth rate does not show quite so constant a trend but the rates for 1942 and 1943 do show a slight decline from the peak rate of 30.8 births per 1,000 population reached in 1941. Infant mortality rates for the six large cities—Tokyo, Osaka, Nagoya, Kyoto, Kobe and Yokohama—show the same trend as the infant mortality rate for the country as a whole but to a more pronounced degree.

TABLE 142.—*Infant mortality rates for Japan's six largest cities, 1937–43*

[deaths under 1 year per 1,000 births]

Year	Tokyo	Osaka	Nagoya	Kyoto	Kobe	Yokohama	6 Cities
1937	77.8	103.4	103.1	87.4	85.7	86.7	87.7
1938	84.0	102.5	106.9	104.7	93.7	96.2	93.3
1939	74.8	110.0	96.2	94.5	90.7	81.2	87.4
1940	57.6	72.4	80.2	69.0	65.3	61.3	64.6
1941	61.3	75.4	84.1	66.1	63.2	69.1	67.7
1942	62.6	79.9	72.6	68.3	68.1	67.0	68.2
1943	64.2	82.0	91.7	71.4	74.1	69.2	71.8

For four of the six cities the rise in the rate began in 1940 rather than in 1941, the year in which it began for the country as a whole, and for all of the cities it was much more pronounced than it was for all Japan. The average rise for the six cities was from 64.6 deaths per 1,000 births in 1940 to 71.8 in 1943 as compared with a rise for the entire country from 84.1 in 1941 to 86.6 in 1943. This suggests that the factors producing this increase were felt earlier in these urban centers and that their effect on the health of infants was more severe than it was in other parts of the country.

The significance of these observations for our study of the effects on health of strategic bombing lies in the fact that they indicate something of the health background of the cities bombed, prior to the beginning of bombing. Even then the stress and privation of war conditions was showing definite effects in the field of health, and the situation was set for an intensification of these conditions such as was produced by strategic bombing to have a very marked effect in the health of the people.

A STUDY OF HOSPITAL ADMISSIONS

General

In view of the lack of the customary records on mortality for the bombing period, an effort was made to secure information from the records of representative general hospitals in seven Japanese cities showing health conditions as reflected in the experience of these hospitals. The cities chosen were Tokyo, Yokohama, Nagoya, Kyoto, Osaka and Kobe, the six largest cities of Japan, and Sendai, the chief city of northern Japan. All of these cities were severely bombed except Kyoto. It was included as a control city to aid in distinguishing the effects of strategic bombing from the more general effects of the war.

In each of these cities several representative general hospitals were asked to provide from their records information showing month of admission and diagnosis of each patient during the months in which the city was bombed and also, for several months prior to and following the bombing period. In this manner records of 43,884 admissions were received from 27 hospitals.

TABLE 143.—*Totals of admissions reported, hospitals represented, and months covered by reports on morbidity information*

City	Number of admissions	Number of hospitals	Number of months covered
Tokyo	9,981	6	11
Yokohama	2,558	2	11
Nagoya	2,812	2	11
Kyoto	10,574	4	12
Osaka	11,440	6	12
Kobe	3,476	3	11
Sendai	2,843	4	6
Total	43,884	27	

For the six large cities the records covered 11 or 12 months but for Sendai, for which the bombing was mostly limited to the month of July, a record of only 6 months, April through September, was requested. For Tokyo, Nagoya, Osaka and Sendai similar records were also secured from one hospital in each city for the same months in 1943–44 as those covered by the 1944–45 records for that city. These 1943–44 records were used as controls in the study of the 1944–45 records for evidences of variation in the diagnosis picture during the bombing period. A list showing the names of the hospitals from which records were secured with the number of admissions reported in each month of the periods covered is shown in Appendix D–1.

Hospital admissions for each month were classified by diagnosis groups and the totals of admissions falling in each of these diagnosis groups were then examined to find the percentage they constituted of the total admissions for the month. The variation in these percentages from month to month through the period under observation was studied to find evidence of any unusual increase in the proportion of cases hospitalized falling in any of the disease groups.

These hospitalized cases do not provide a comprehensive representation of the illness picture in the cities studied. The most they can presume to show is change in the diagnosis pattern of the more severe cases of illness such as are normally hospitalized. These more severe cases, however, do provide a fairly satisfactory indication of the relative prevalence of different types of illness at any one time; furthermore, it is these more severe illnesses that have special interest for the purposes of our study because of their more pronounced effect on the life and morale of the community.

Scarcity of food and personnel in the hospitals during the bombing period discouraged patients from seeking hospitalization. This probably had some effect on relative distribution by diagnosis of the cases admitted. However, it was the opinion of hospital authorities that it was the less severe cases of all diagnoses which were kept at home and that consequently the relative prominence of the various diagnoses among the cases admitted was not materially affected.

Accidents, and Infections and Parasitic Diseases

It is natural to expect that the diagnosis group covering accidents would be among those showing an increase in admissions during the bombing period wherever the established hospitals were used for relief purposes. This work was of course done to some extent through emergency facilities set up for the occasion and the hospital records on this diagnosis group are consequently not especially significant. They do, however, rather definitely reflect the bombings of Tokyo, Yokohama, Nagoya and Sendai (Figure 52). The Osaka report apparently also shows accidents recorded under diseases of the skin (presumably burns) and diseases of the bone and organs of locomotion (presumably fractures) as shown in Figure 53. This error in diagnosis classification may have also been committed in certain hospitals in other cities of any other city as it is in that of Osaka. As the record provided here of hospitalizations for care of accidents is incomplete and accidents are discussed in detail in the chapter on air-raid casualties, no further attention will be given them in this chapter.

Like admissions for accidents, admissions for infectious and parasitic diseases are reflected only partially in the records of general hospitals because special provision is made for their care in infectious disease hospitals. However, they constituted a significant percentage of the monthly admissions in the hospitals studied (Figure 52). For most of the hospitals, the records of admissions under this diagnosis group do not show any variations that are especially significant. The rise in the percentage of admissions which come under this diagnosis group in Yokohama and Kobe during the summer of 1945 is accounted for in both cities entirely by admissions for typhoid and paratyphoid fever. A second line on the graph for these cities indicates that there is actually a drop in the percentage of infectious and parasitic diseases exclusive of typhoid and paratyphoid fever during these summer months. These outbreaks of typhoid and paratyphoid fever in Yokohama and Kobe as well as other outbreaks of notifiable communicable diseases in all cities covered by this study, except Sendai, are discussed in detail in the chapter on Notifiable Diseases.

These four disease groups (accidents, diseases of the skin, diseases of the bone, and infectious and parasitic diseases) are in a manner extraneous to the main purpose of this study. As hospitalization also is provided for these diseases in other than general hospitals, our records of hospitalized cases for these disease groups are manifestly incomplete. Furthermore, as has already been noted, more detailed studies of these subjects than is possible on the basis of the data available here will be found elsewhere in this report.

In order to secure a more satisfactory analysis of the other diagnosis groups under consideration, they will be studied as a group separate and distinct from the four to which reference has been made above. The removal of admissions covering illnesses coming under these four diagnosis groups has the effect of considerably reducing the month-to-month variation in admission totals (Figure 54). This provides totals which more accurately reflect the relative variations among the more general diagnoses for which cases are admitted to general hospitals.

These diagnoses have been arranged in the following 11 groups:

(1) Diseases of the digestive system.
(2) Diseases of the respiratory system.
(3) Diseases of the circulatory system.
(4) Diseases of the nervous system.
(5) Diseases of the eye.
(6) Diseases of the ear and mastoid process.
(7) Nutritional and other general diseases including acute rheumatic fever.
(8) Cancer and tumors.
(9) Diseases of the genito-urinary system.
(10) Diseases of pregnancy and childbirth.
(11) Other diseases including:

(a) Diseases of early infancy.
(b) Congenital malformations.
(c) Senility.
(d) Diseases of the blood.
(e) Chronic poisonings.
(f) Ill-defined diseases.

Hospital admissions for diseases falling in these 11 groups have been distributed on a percentage basis. The percentage of diagnoses falling in each group for each month covered by the study is indicated in the graphs accompanying the discussion of the various groups.

For Tokyo, Nagoya, Osaka and Sendai similar information was also secured for corresponding months in 1943–44 in order to compare variations from month to month without bombing with variations during the same months in the presence of bombing. For these four cities the percentage of admissions with diagnoses falling in the various diagnosis groups in 1943–44 is shown by dotted lines in the various graphs.

Diseases of the Digestive System

The group showing the broadest variation in percentage of admissions during the months when bombing was most severe was that covering diseases of the digestive system (Figure 55). This is in some degree due to normal increase of digestive disorders during the summer months. It is only to the extent that the increase in the proportion of this group of diagnoses can be shown to be unusually large during the summer of 1945 that any claim can be made that it was affected by bombing. The increases for Tokyo and Osaka are greater than those for 1944, with definite peaks in July. While corresponding 1944 figures are not available for Kobe and Yokohama, they also show very high percentages of admissions for digestive diseases during the summer months with the peaks in June and July. A more detailed analysis of the records of these four cities indicates that for Osaka and Yokohama the summer increases are largely due to diarrhea and enteritis, while for Kobe, hernia also stands high among the diagnoses, and for Tokyo, appendicitis is relatively prominent (Figure 56). The connection between bombing and an increased incidence of diarrhea and enteritis in Yokohama and Osaka is easily understood. It is doubtful, however, that any relationship can be established between bombing and incidence of hernia in Kobe or appendicitis in Tokyo.

Diseases of the Respiratory System

The percentage of hospital admissions which were for respiratory ailments was considerably lower in 1945 than it was in 1944 for the hospitals studied in both Tokyo and Nagoya (Figure 57). For Kobe and Osaka there is some indication of a higher relative incidence of respiratory diseases than usual during June, July and August and for Yokohama there is evidence of an increase in hospital admissions for respiratory ailments in May, the month of their most severe bombing. Study of the more specific diagnoses included under the head of respiratory diseases indicates that for all three cities the diseases responsible for these increases were pleurisy, bronchitis and broncho-pneumonia (Figure 58). Comparison of the relative prominence of pleurisy, bronchitis, and pneumonia (except lobar) among the diagnoses for which cases were admitted to the hospitals studied in Osaka in 1944 and 1945 indicates that these diseases were considerably more frequent among hospital admissions in 1945 than in 1944 (Figure 59).

These observations indicate that bombing may have been accompanied by some increase in pleurisy, bronchitis and broncho-pneumonia in some of the cities studied. This probably reflects a corresponding or even more pronounced increase in colds and other respiratory ailments not sufficiently severe to require hospitalization.

It is natural to expect that with the destruction of houses and other means of shelter from the elements as a result of bombing there would be some increase of respiratory diseases, particularly in a humid climate such as is found in Japan. There is no evidence, however, of this increase being especially marked for any of the diagnoses observed. It should be noted in this connection that no evidence was found of an increased incidence of influenza in 1945 in any of the records studied.

Diseases of the Circulatory System

Only very slight variations from month to month in the proportion of cases admitted to hospitals for the care of diseases of the circulatory system were noted in the records studied

BOMBING EXPERIENCE AND HOSPITAL ADMISSIONS FOR

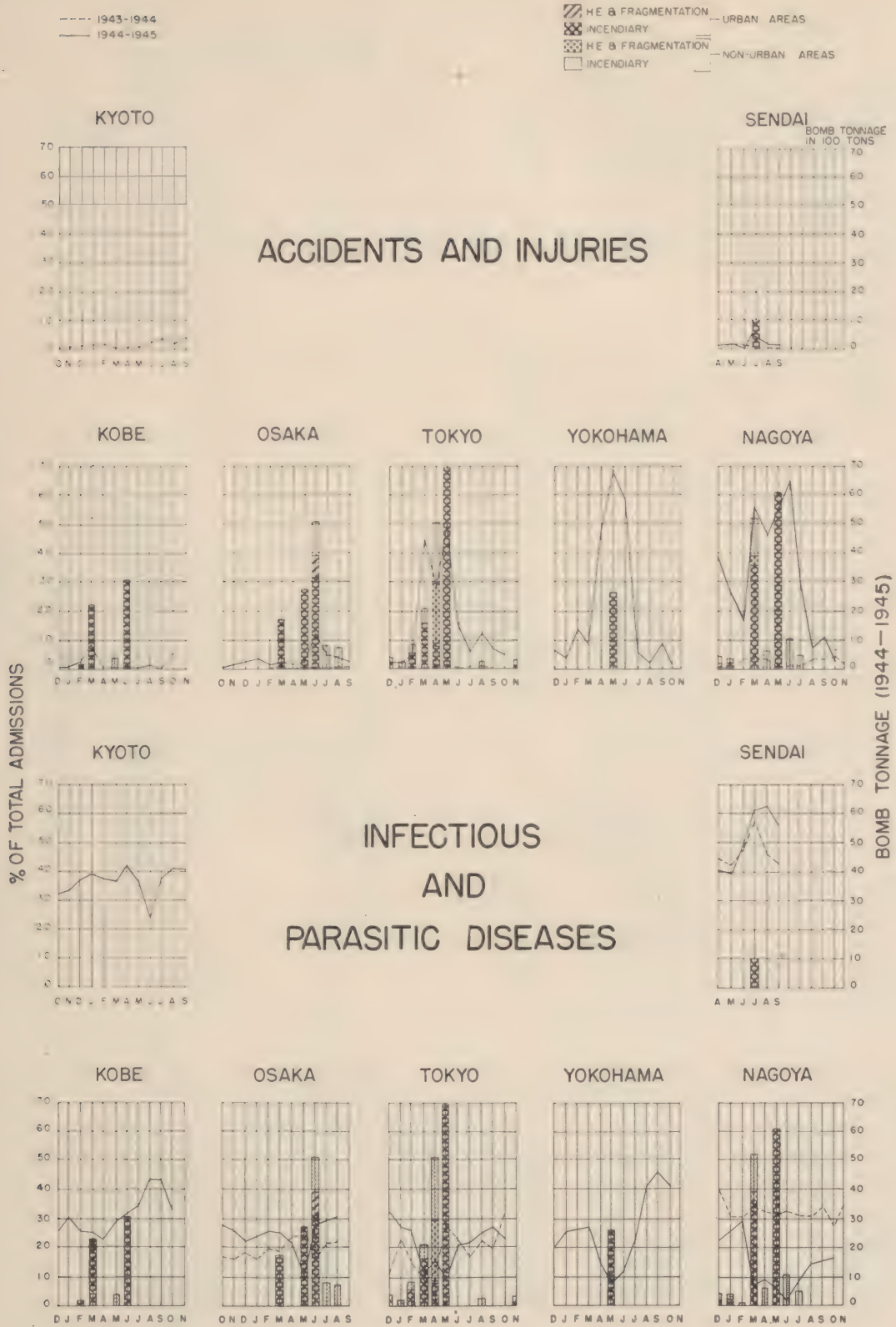


FIGURE 52

BOMBING EXPERIENCE AND HOSPITAL ADMISSIONS FOR

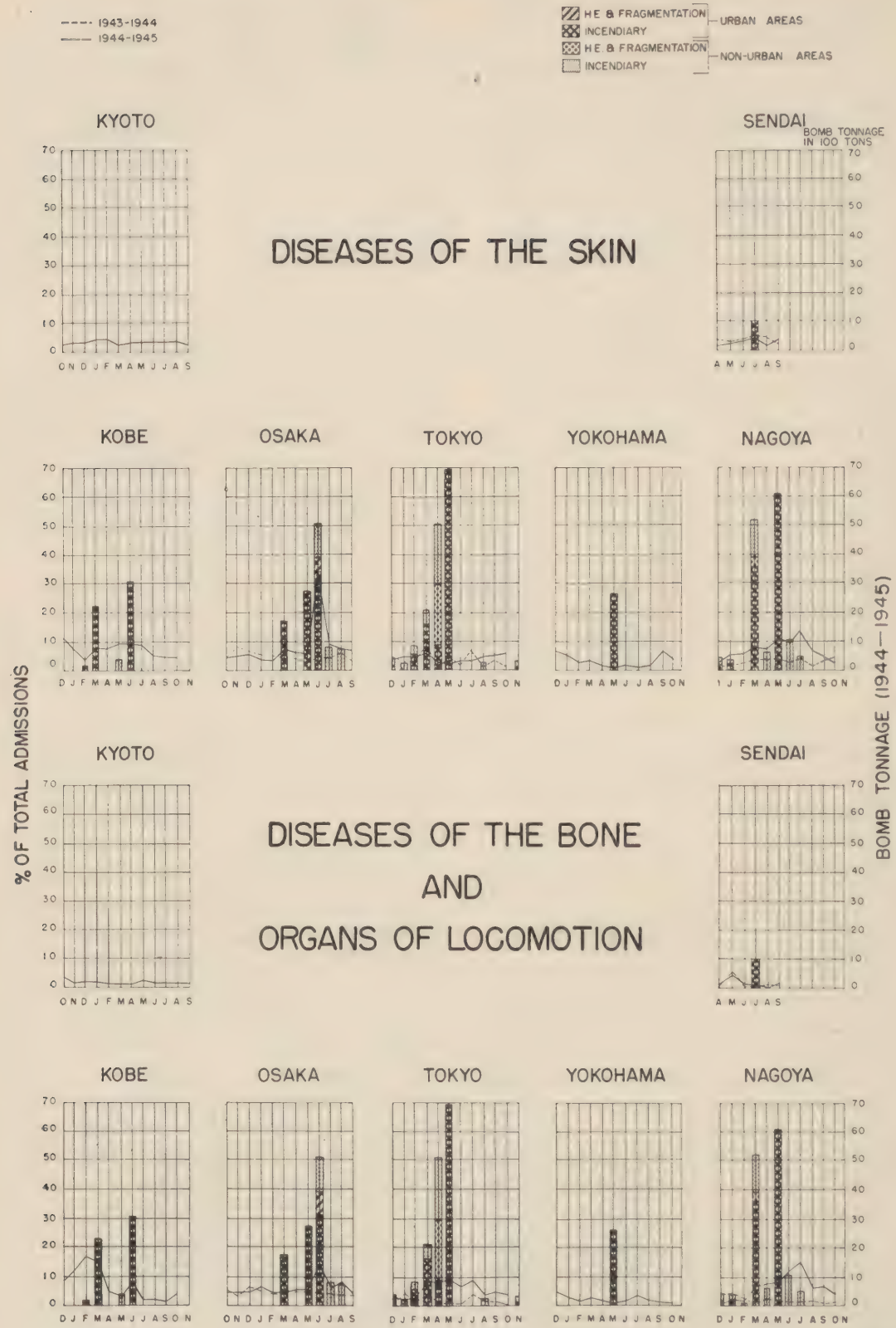


FIGURE 53

GENERAL MORBIDITY

AS SHOWN BY

HOSPITAL ADMISSIONS

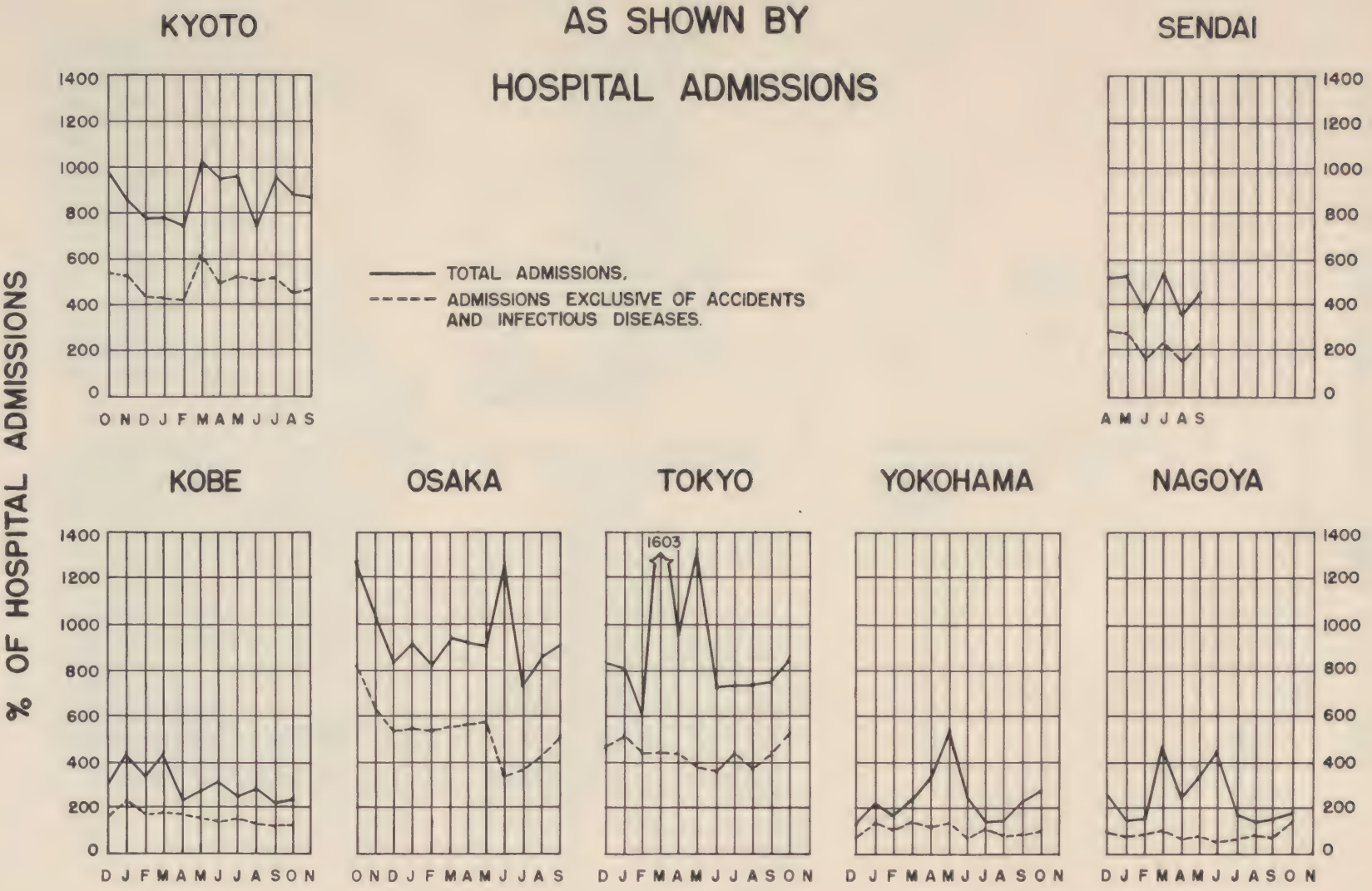


FIGURE 54

BOMBING EXPERIENCE AND HOSPITAL ADMISSIONS FOR

DISEASES OF THE DIGESTIVE SYSTEM

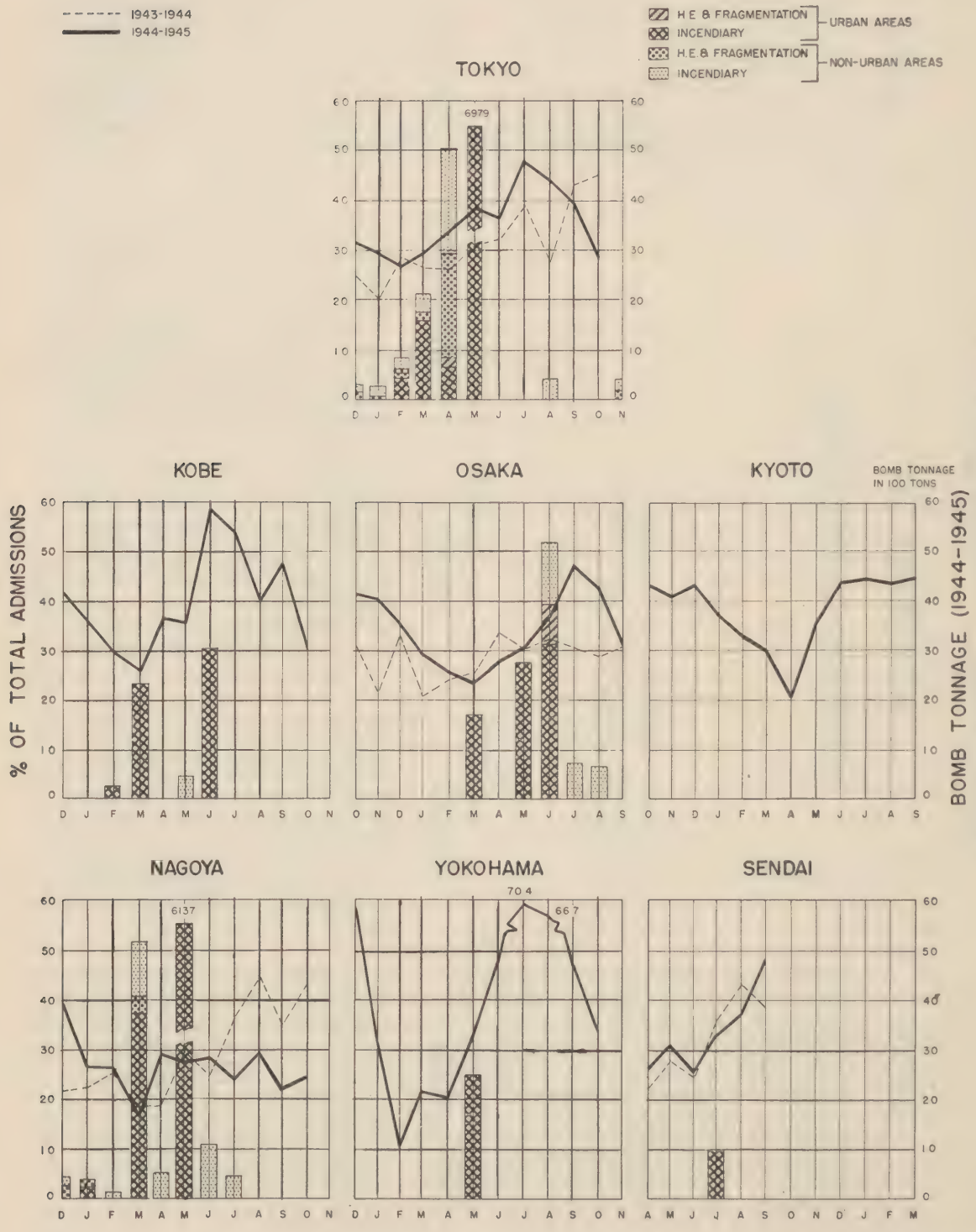


FIGURE 55

RELATIVE FREQUENCY OF HOSPITAL ADMISSIONS

FOR SPECIFIC DIAGNOSES UNDER

DISEASES OF THE DIGESTIVE SYSTEM

(1944-1945)

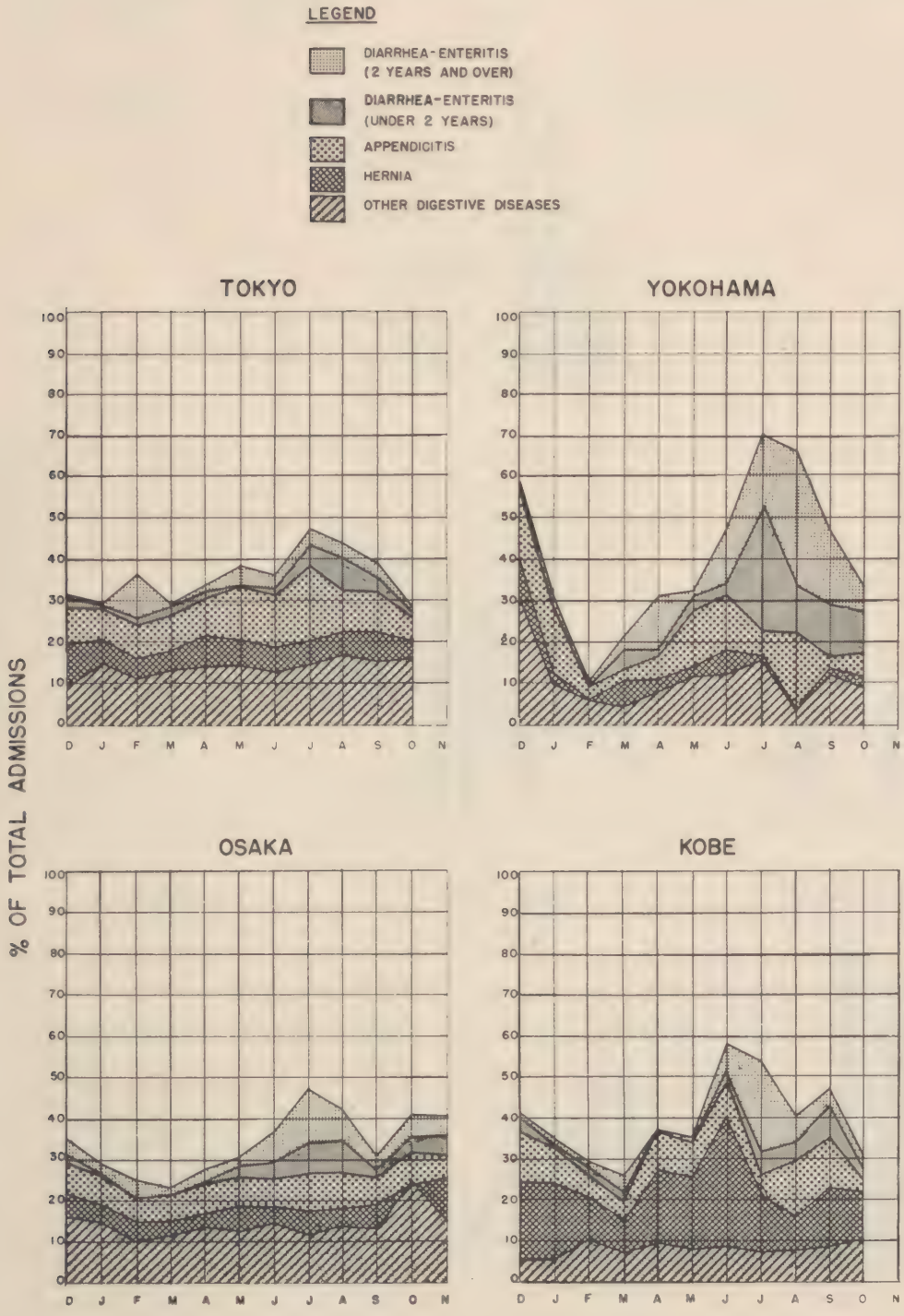


FIGURE 56

BOMBING EXPERIENCE AND HOSPITAL ADMISSIONS FOR

DISEASES OF THE RESPIRATORY SYSTEM

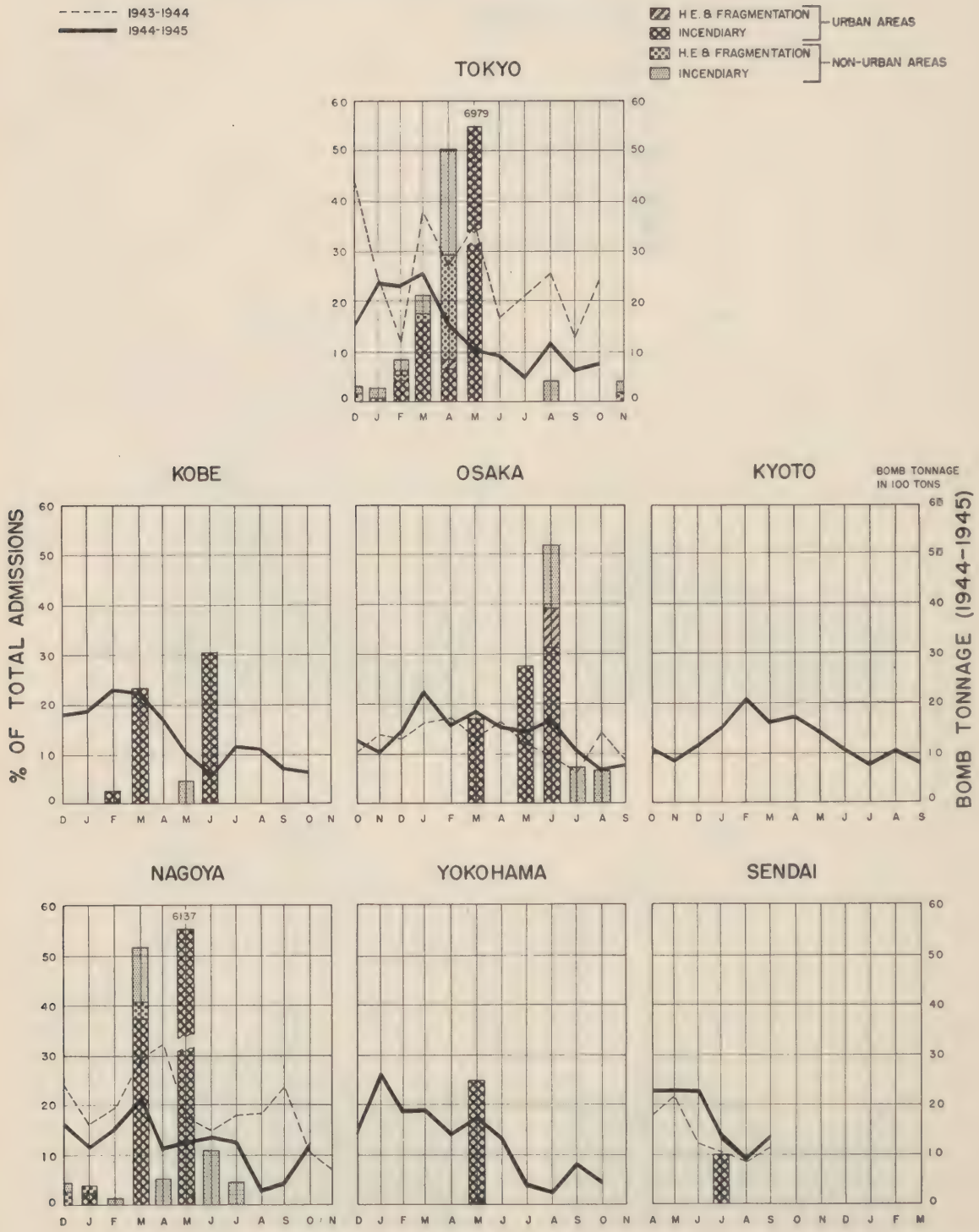


FIGURE 57

RELATIVE FREQUENCY OF HOSPITAL ADMISSIONS

FOR SPECIFIC DIAGNOSES UNDER

DISEASES OF THE RESPIRATORY SYSTEM

(1944–1945)

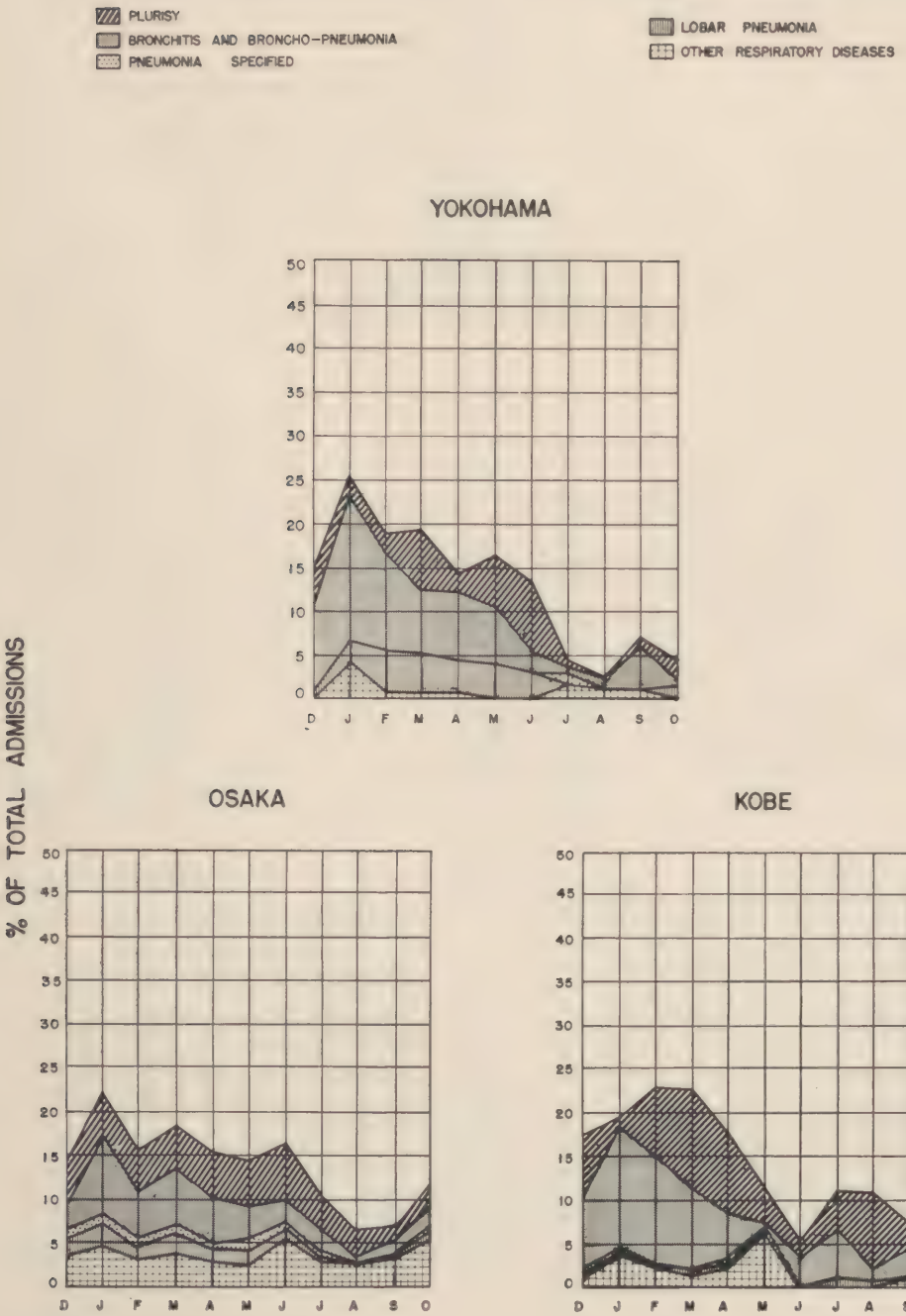


FIGURE 58

RELATIVE FREQUENCY OF HOSPITAL ADMISSIONS FOR BRONCHITIS AND PNEUMONIA (EXCEPT LOBAR PNEUMONIA)

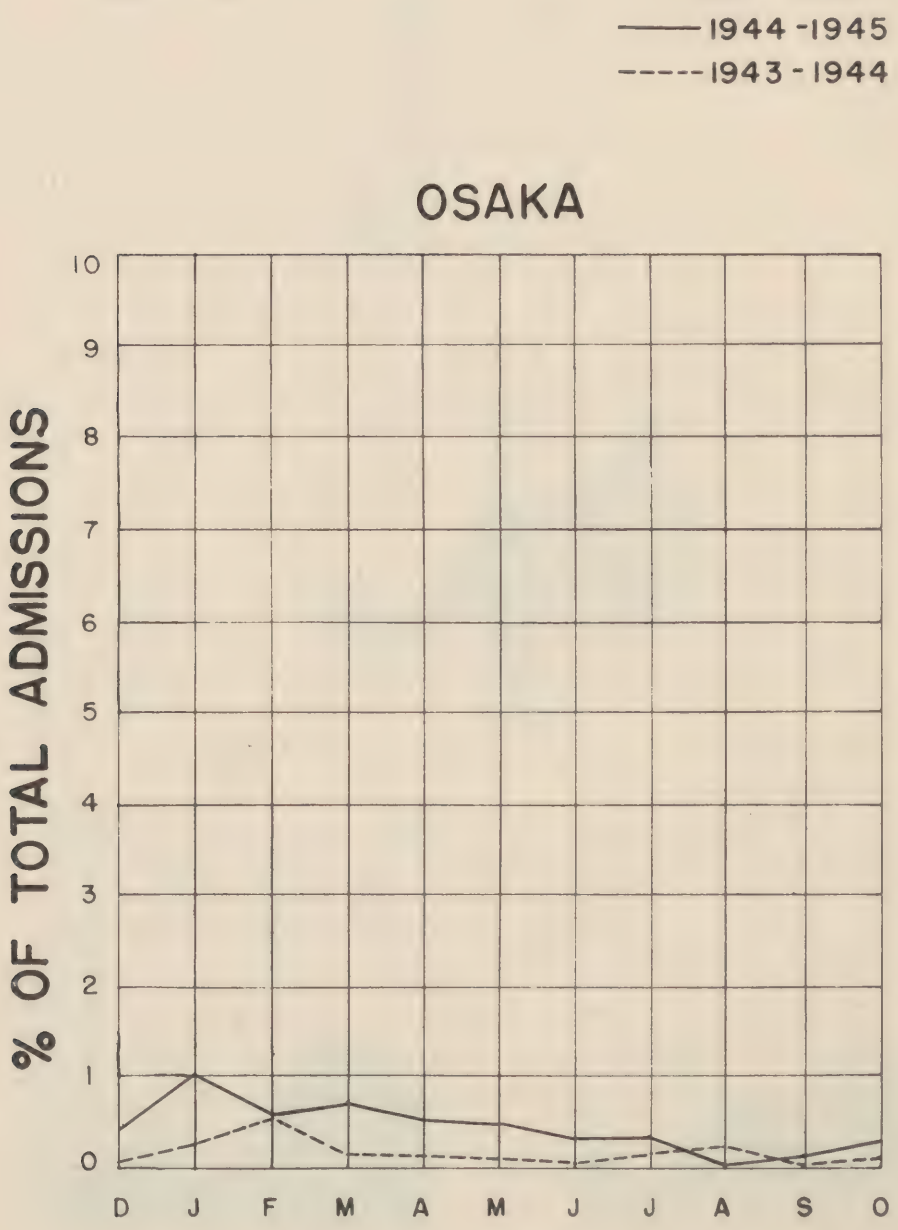


FIGURE 59

BOMBING EXPERIENCE AND HOSPITAL ADMISSIONS FOR DISEASES OF THE CIRCULATORY SYSTEM

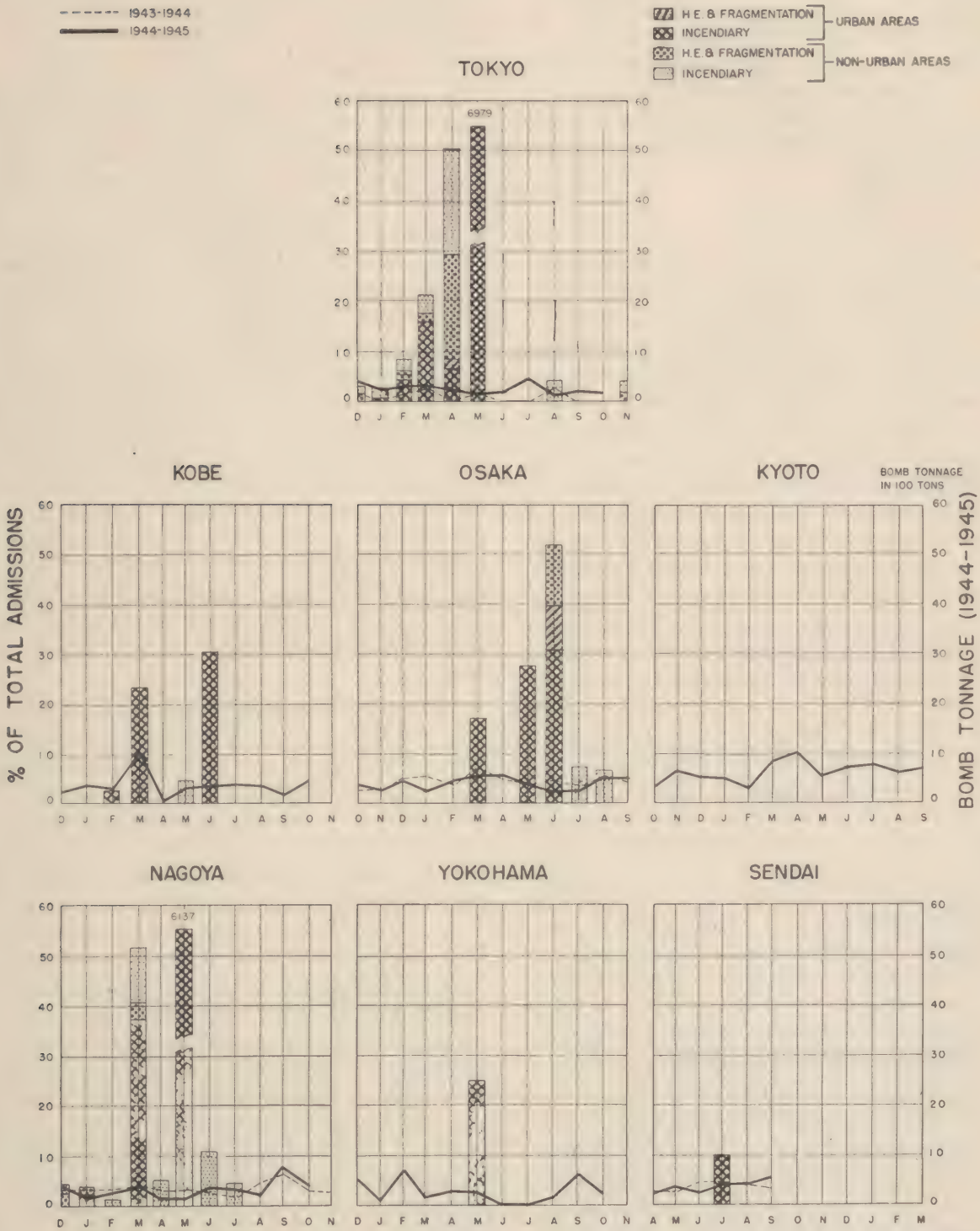


FIGURE 60

for 1945 (Figure 60). The widest variation noted was for Kyoto, which was not severely bombed, indicating that variations such as did occur would probably have occurred in the absence of bombing. Furthermore, for the four cities for which 1944 records are available, the proportion of hospital admissions for care of diseases of the circulatory system in 1945 is prevailingly lower than the corresponding rate for 1944. It seems evident, therefore, that the test we have applied does not reveal any effect of bombing on the incidence of diseases of the circulatory system.

Diseases of the Nervous System

The percentage of hospital admissions for diseases of the nervous system was consistently higher in 1945 than it was in 1944 for the hospitals studied in Tokyo, and also, in Nagoya. For Osaka the percentage of admissions for 1945 was lower. The records of Sendai for the two years correspond very closely (Figure 61). Nagoya shows a rise in the percentage of admissions for diseases of the nervous system in July, following heavy bombing in June.

Detailed analysis of the Tokyo record of admissions for diseases of the nervous system in 1945 shows that the most frequent diagnosis was dementia praecox and other psychoses, with non-epidemic meningitis standing second, and general paralysis of the insane and cerebral hemorrhage holding third and fourth places (Figure 62). The outstanding rise in the rate for June seems to have been evenly distributed among the various diagnoses. Cases admitted for dementia praecox and other psychoses, however, were more preponderant during the latter half of the year.

For Nagoya the June rise in the proportion of hospital admissions for diseases of the nervous system was found to be accounted for largely by an increase in the number of admissions for cerebral hemorrhage (Figure 62). This diagnosis was most prominent among those covering admissions for diseases of the nervous system in Nagoya all through the year.

Additional information in this field of diseases of the nervous system was secured from psychiatric hospitals in Yokohama and Kobe. This information consisted of records of admissions from several months before the attacks began to several months after they terminated, showing the diagnosis of each case and the month in which it was admitted to the hospital.

Similar records also were requested for the corresponding months in the previous year so that comparison might be made between the number of admissions and the diagnoses for which they were admitted in the presence and in the absence of bombing.

Since the bombing period for Yokohama and Kobe was rather extended, these records were requested for two full years, from November 1943 through October 1945. Admissions to these institutions were from the surrounding areas as well as from the cities themselves, but the population of Yokohama and Kobe is sufficiently large to make admissions from the cities easily predominate in the records of the institutions.

The record for Yokohama shows an increase in admissions in 1944–45 over 1943–44 of almost 50 percent. If this increase is expressed in terms of admissions per 100,000 population in order to allow for the great decrease in the population of the city as a result of bombing in 1945, this rate rose from 19.6 admissions per 100,000 population per year in 1943–44 to 37.1 per 100,000 in 1944–45, an increase of 89.3 percent (Table 144). The record for Kobe, on the other hand, shows a slight decrease in 1944–45 from 1943–44, the rate for 1944–45 being 15.3 percent lower than that for the previous year.

Analysis of the diagnoses covering these admissions indicates that for both cities, dementia praecox and other psychoses was the predominant diagnosis group in both years studied but that the percentage of diagnoses falling in this group in 1944–45 was slightly smaller than it was in 1943–44. The proportion of cases admitted for general paralysis of the insane, the diagnosis next in prominence, was larger in 1944–45 than it was in 1943–44 in both cities.

When the record of these cases is studied by month of admission (Figure 63) the most striking observation is the tremendous number of admissions in Yokohama during the month of May 1945. A total of 97 persons were admitted and indicate a rate of 152 per 100,000 persons per year, or about four times the average rate for the year. Seventy percent of the admissions included in this May total were admitted for dementia praecox and other psychoses and 23 percent for general paralysis of the insane.

BOMBING EXPERIENCE AND HOSPITAL ADMISSIONS FOR DISEASES OF THE NERVOUS SYSTEM

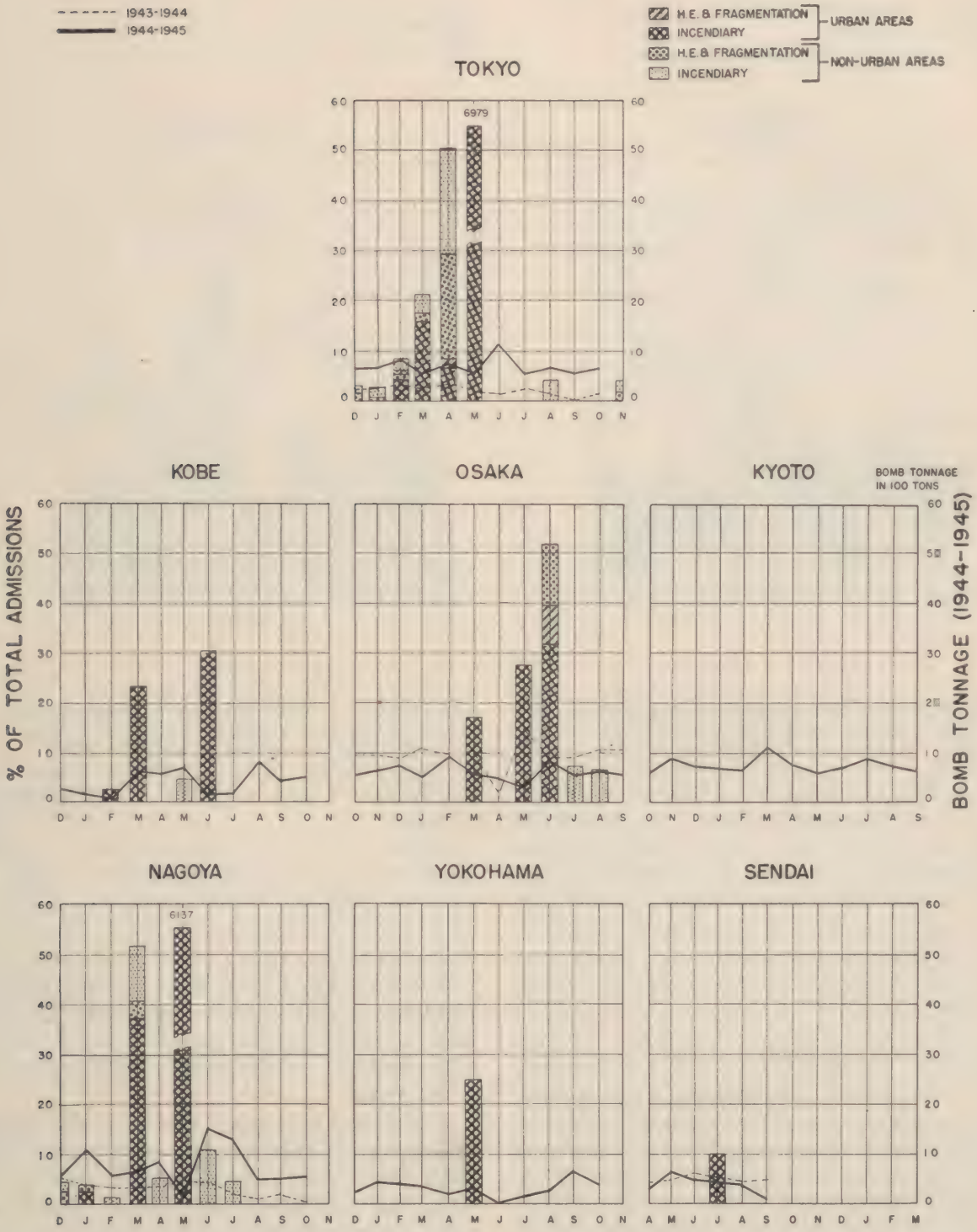


FIGURE 61

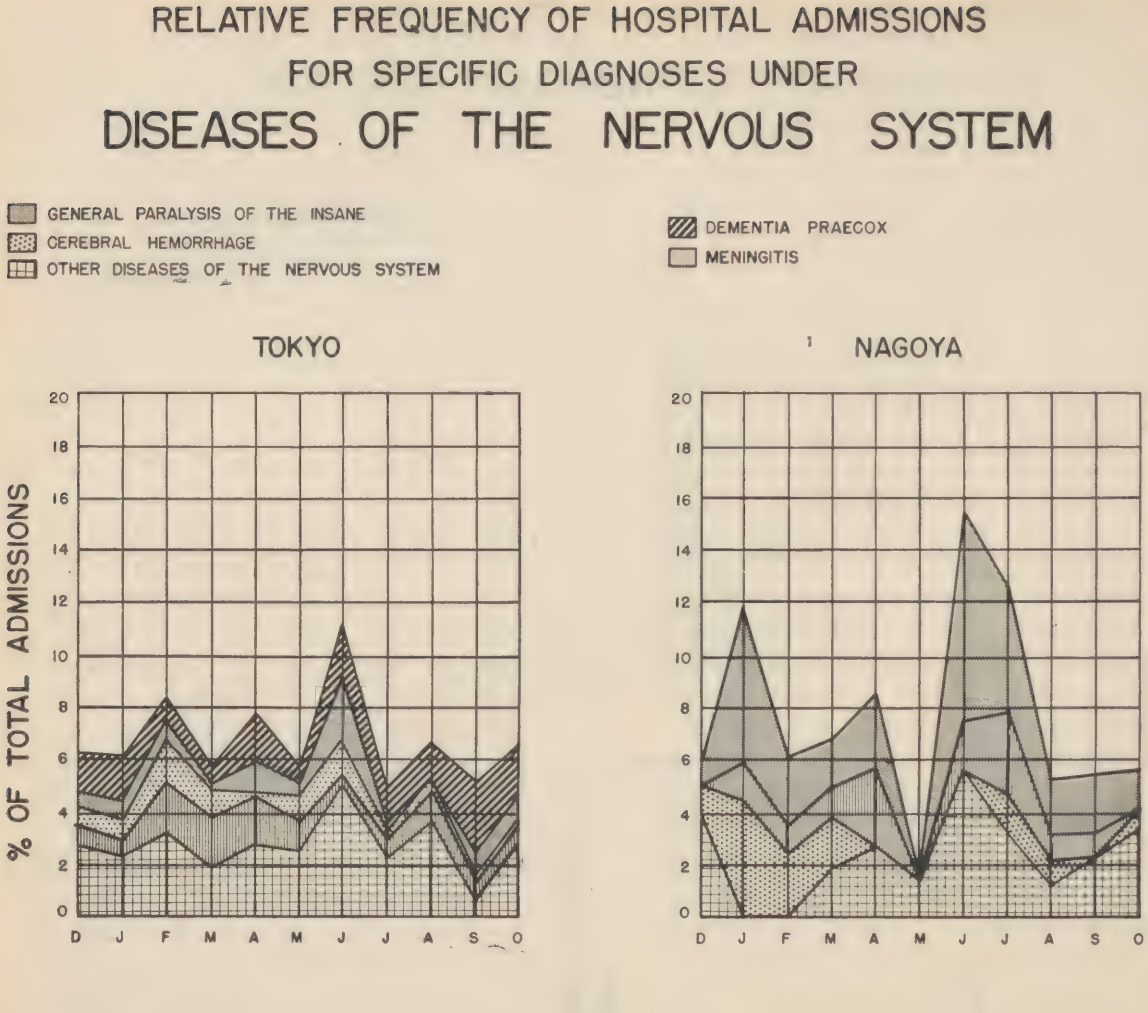


FIGURE 62

These are about the percentages prevailing for the year (Table 144). There does not seem, therefore, to be any special diagnosis accounting for this extraordinary increase in admissions. As is indicated in Figure 61, May is the month of Yokohama's most severe bombing. Some claims may be made to a causal relationship between these two phenomena although this is rather a pronounced effect to attribute to this particular bombing in the absence of other comparable records of similar effects elsewhere.

It will be noted, however, that for the rest of the year the monthly rates for Yokohama, with the exception of the rate for August, show a larger increase over the rates for 1943–44 than do the rates for the earlier months of the year. This is also true for Kobe. The rates for the last 3 months for that city show a pronounced increase over those for the corresponding months in 1944 (Figure 63). This may be attributed at least in part to the mental and nervous strain to which bombing subjected the people, although the increasing stress of war conditions is also a factor to be taken into account.

Another indication of the mental and nervous condition of a population is the number of suicides. Records of suicides were secured from the police departments in Tokyo, Yokahoma, Nagoya, Kyoto, Osaka, Kobe and Sendai. For Tokyo and Yokohama, they covered only the bombing periods and several months preceding and following but for the other five cities they also covered corresponding periods in the previous years.

For these five cities the rate per 100,000 population in 1944–45 was consistently higher than for 1943–44. The average rate for the five cities in 1943–44 was 11.7 per 100,000 persons, while in 1944–45 it was 18.7, an increase of 60 percent. The rate for Sendai in 1945 was

ADMISSIONS TO PSYCHIATRIC HOSPITALS

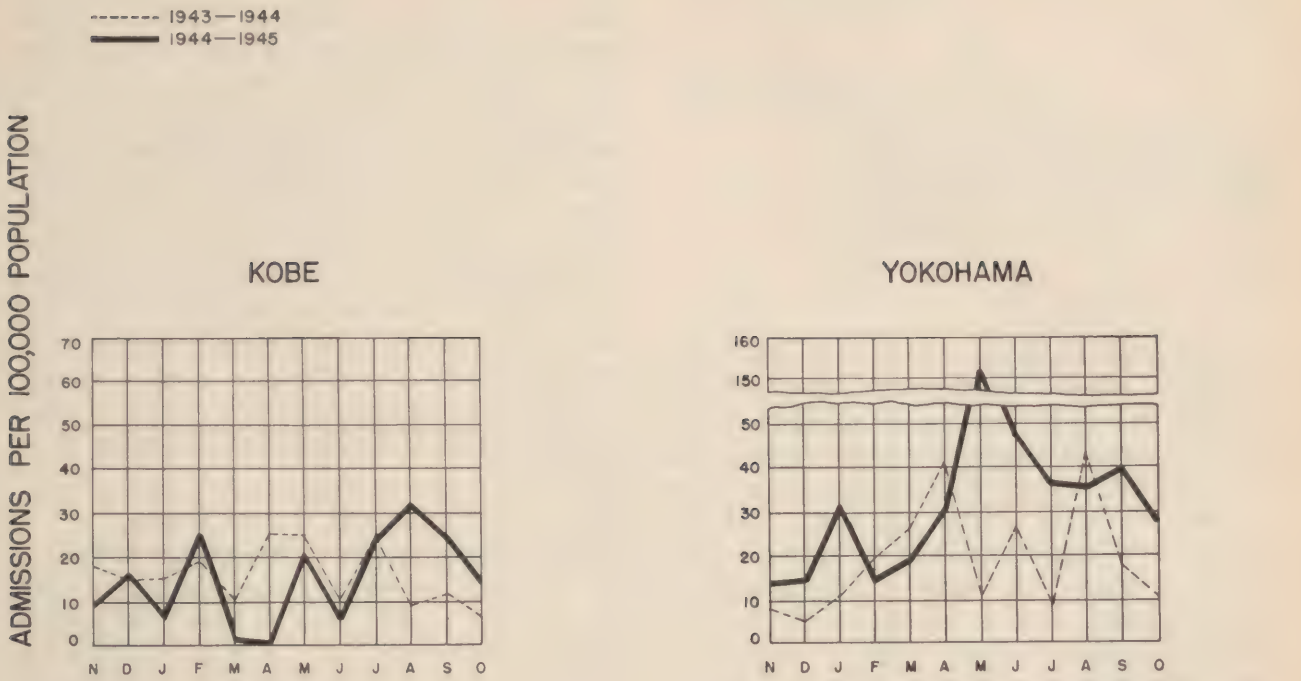


FIGURE 63

TABLE 144.—*Number and percent of admissions to psychiatric hospitals for various diagnoses from November 1943 through October 1945 in Yokohama and Kobe*

Diagnosis	Yokohama		Kobe		Both cities	
	1943–44	1944–45	1943–44	1944–45	1943–44	1944–45
	Number of admissions					
General paralysis of the insane	35	61	17	12	52	73
Dementia praecox and other psychoses	135	181	121	64	256	245
Epilepsy	9	11	5	6	14	17
Other causes	20	37	4	2	24	39
Total	199	290	147	84	346	374
	Percentage					
General paralysis of the insane	17.6	21.0	11.6	14.3	15.0	19.5
Dementia praecox and other psychoses	67.8	62.4	82.3	76.2	74.0	65.5
Epilepsy	4.5	3.8	3.4	7.1	4.0	4.5
Other causes	10.1	12.8	2.7	2.4	7.0	10.5
Total	100.0	100.0	100.0	100.0	100.0	100.0
Number of admissions per 100,000 persons	19.6	37.1	16.3	13.8	18.1	26.9
Percent change in 1944–45		+89.3		−15.3		+48.6

TABLE 145.—*Number of suicides per 100,000 persons per year in 1944 and 1945 in seven Japanese cities*

City	Period	Rate		Total	
		1943–44	1944–45	1943–44	1944–45
Tokyo	January–October 1945		14.0	[1]	498
Yokohama	November 1944–August 1945		9.9	[1]	67
Nagoya	November 1943–October 1945	6.4	13.8	90	132
Kyoto	January 1944–October 1945	33.0	44.3	312	329
Osaka	October 1943–September 1945	8.9	13.9	251	252
Kobe	October 1943–September 1945	7.2	10.9	66	71
Sendai	April 1944–September 1945	5.6	16.6	8	21
Total, 5 cities		[2] 11.7	[2] 18.7	727	1,370

[1] No report. [2] Average.

three times that for 1944 and for Nagoya it was twice the 1944 rate. Sendai submitted a report which undertakes to give the reason for each suicide.

According to this report, five of the suicides in 1945 were due to "insanity by bombing" and eight more were due to "pain of living and bombing." These 13 suicides account for the difference between the 1944 and 1945 totals and definitely relate the marked rise in Sendai's suicide rate to bombing.

All of the reports except that from Sendai show the number of suicides during each month of the period covered. Rates based on these figures show a tendency to reach a peak during the latter half of 1945 for all the cities studied

TABLE 146.—*Suicides in Sendai from April through September 1944 and 1945*

Cause	From April through September					
	1944			1945		
	Male	Female	Total	Male	Female	Total
Pains of sickness and pessimism	2	3	5	0	3	3
Dementia praecox	0	0	0	1	2	3
Insanity by bombing	0	0	0	2	3	5
Pain of living and bombing	0	0	0	1	7	8
Hunger	1	0	1	0	0	0
Pessimism	1	0	1	1	0	1
Other	1	0	1	1	0	1
Total	5	3	8	6	15	21

and, for those cities for which 1944 rates also are shown, there is no evidence except possibly in Kyoto of a comparable peak during the same period in 1944 (Figure 64). This would indicate that the 1945 peak is due to factors peculiar to 1945. For four of the cities it occurs in August and may be associated with the surrender. However, in Osaka and Yokohama it came too early to be accounted for by the surrender and even in other cities for which the peak was reached in August (notably Nagoya) there was a pronounced rise during earlier months. It seems reasonable to attribute this to the increasing strain of the war which bombing had a large part in producing, although there does not seem to be any close correlation for any of the cities between the months for which high suicide rates are shown and the months in which they were subjected to more severe bombing.

Diseases of the Eye

Returning to the study of hospital admissions, a review of the records on admissions for disease of the eye shows the proportion of admissions which were for this cause to have been relatively uniform through 1945 for most of the cities studied. For those cities for which 1944 rates were available, the rates for the two years conform closely (Figure 65). The one city for which this statement does not remain true was Nagoya. The report of this city showed a marked increase in the proportion of admissions for eye disorders during the months of most severe bombing against a background of few admissions for this cause during the corresponding months of the previous year. It is rather surprising not to find this situation also existing in the other cities.

The chapter on air-raid casualties shows a great many eye injuries to have resulted from exposure to heat, smoke and gas in connection with the fires produced by bombing. While such injuries themselves did not generally require hospitalization for treatment, it would seem that complications resulting from such injuries would be sufficiently frequent to cause some rise in hospital admissions. It is possible that such conditions might be classified by the hospital reporting them as injuries rather than diseases of the eye. In that case they would of course not be counted in the group under consideration. As the record stands, except in the case of Nagoya, there does not seem to be much evidence that bombing had any particular effect on admissions to hospitals for treatment of eye conditions.

Diseases of the Ear and Mastoid Process

The evidence with reference to disease of the ear and mastoid process is similar to that on diseases of the eye. For most of the cities studied the proportion of cases admitted for treatment of diseases of the ear remained relatively constant through the year. For cities for which comparable records for 1944 were available, the rates for the two years were reasonably uniform (Figure 66). An outstanding exception to this statement is noted in the case of Yokohama. A very high proportion of its hospital admissions were found to have been for diseases of the ear during 1945 in every month for which records are available except September. The peak months were February, March and April, for which an exceeding high rate is shown. This, however, was prior to the first extensive air attack of Yokohama in May and so cannot be attributed to bombing. The rise in the June rate over that for May might possibly be attributed to the effect of bombing on this already existing situation, but it is not very marked and so does not deserve special consideration.

The record for Nagoya shows a rise for June and July which may have significance for this study in view of the relatively extensive use of high-explosive bombs in attacking this city in June. The chapter on air-raid casualties mentions the large number and peculiar nature of the casualties resulting from this raid and it is logical to expect that the effect on the eardrum of the air blast following the explosion

BOMBING EXPERIENCE AND SUICIDES

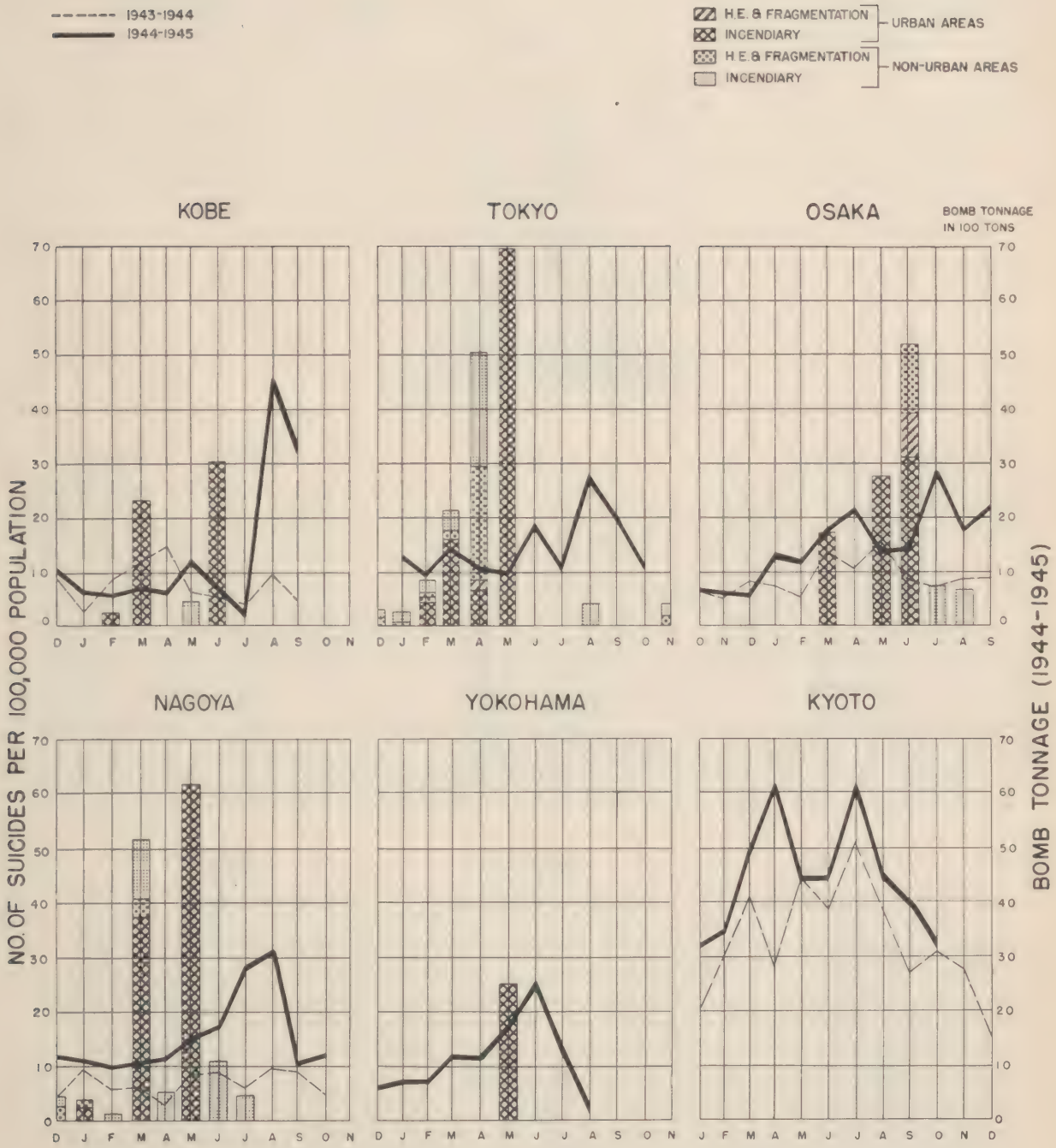


FIGURE 64

BOMBING EXPERIENCE AND HOSPITAL ADMISSIONS FOR

DISEASES OF THE EYE

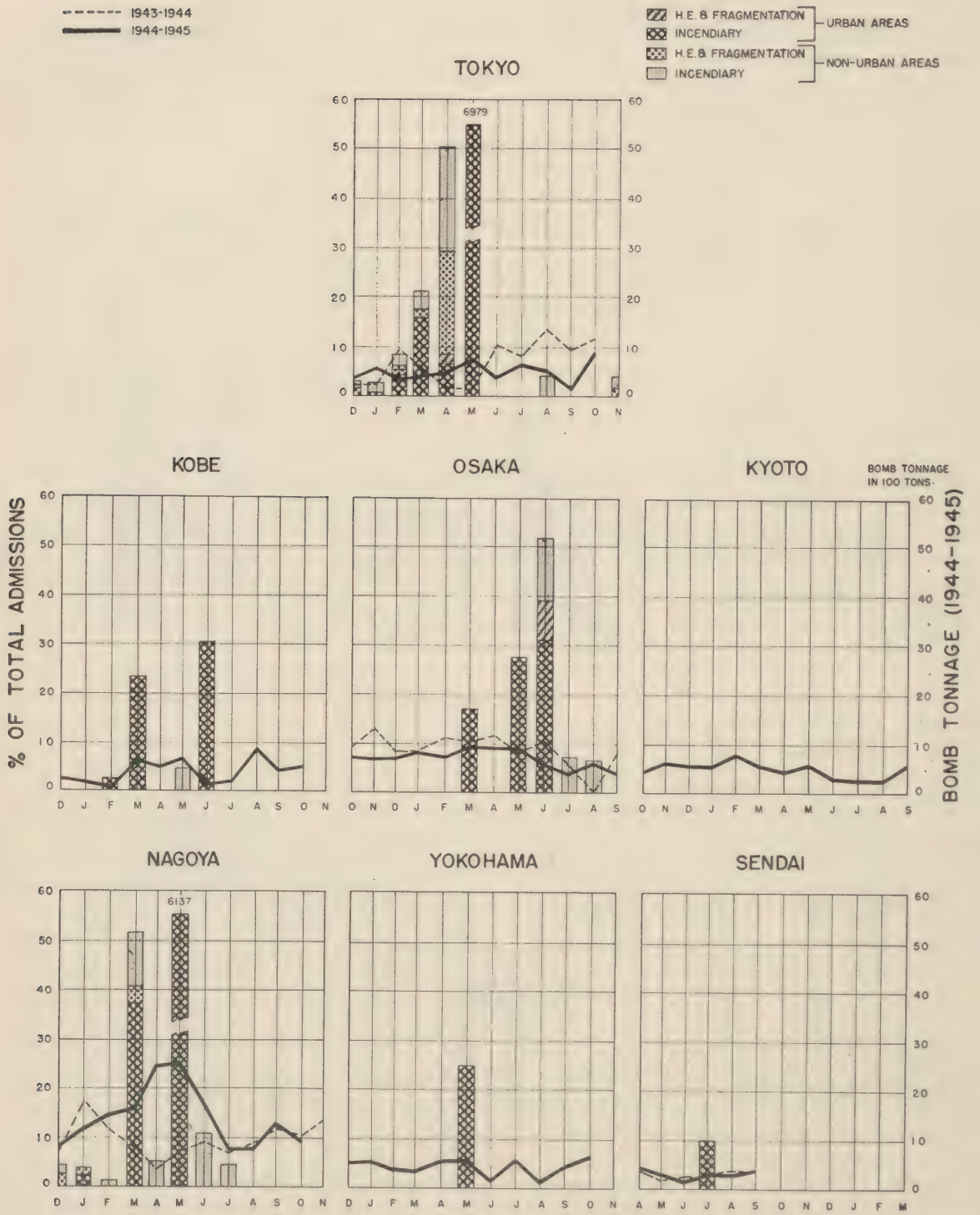


FIGURE 65

BOMBING EXPERIENCE AND HOSPITAL ADMISSIONS FOR

DISEASES OF THE EAR AND MASTOID PROCESS

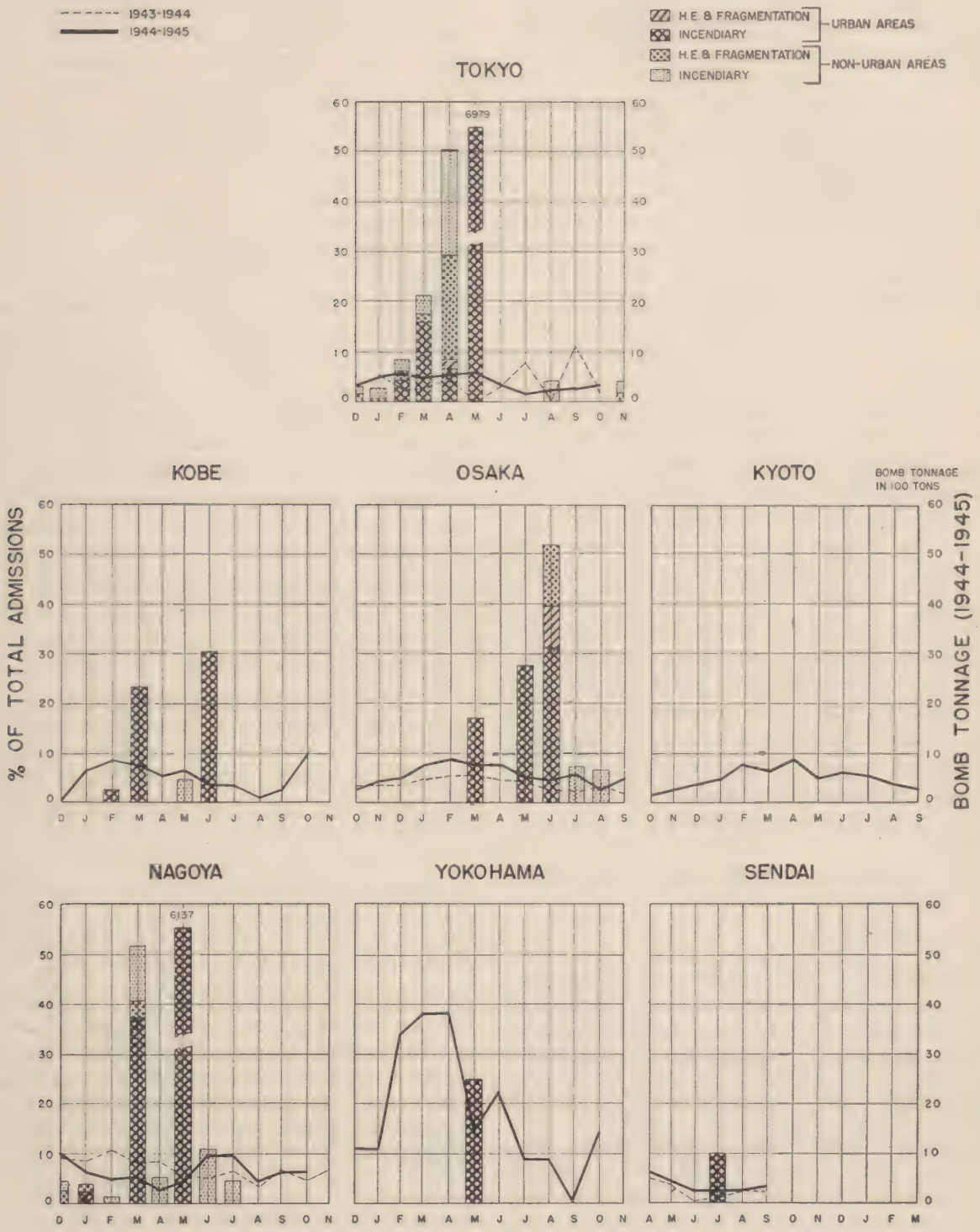


FIGURE 66

of high-explosive bombs would result in an increase of disorders of the ear such as is reflected in this record for Nagoya.

Nutritional and Other General Diseases, Including Acute Rheumatic Fever

The proportion of hospital admissions which were for nutritional and general diseases and acute rheumatic fever was so small that no very definite conclusions can be drawn from their study. In general, they constituted less than five percent of the total admissions and there is no outstanding variation in this percentage during the months under consideration (Figure 67). The slight increase shown for Sendai in August, following the bombing in July, is due to an increase in cases of beriberi and diseases of the endocrine glands.

The record for Kobe shows a higher proportion of cases admitted for diseases falling in this diagnosis group than was found for the other cities studied. A detailed analysis of the specific diagnoses of cases included in this group in Kobe showed the predominant diagnosis especially during the latter part of the year to be diseases of the endocrine glands (Figure 68). The diagnosis group next in prominence was rheumatism and osteoarthritis, with acute rheumatic fever third, and beriberi fourth (Figure 68). Some significance may be found in the increase in prominence of diseases of the endocrine glands in Kobe during the latter part of 1945 if it is granted that a sense of alarm such as would be produced by bombing of populated areas is a possible cause of such disorders. However, as has already been pointed out, the limitations on available data make it impossible to definitely establish a relationship between bombing and endocrinological disorders in this study.

Cancer and Tumors

The records of hospital admissions for treatment of cancer and tumors during 1945 in the seven cities studied shows no considerable variation from normal (Figure 69). In general, the proportion of admissions coming under this diagnosis group is relatively uniform and, where the corresponding records for the previous year are available, the two compare rather closely. The widest variation is shown for Tokyo, which had an appreciable though not especially marked increase in diseases falling in this category during the latter half of 1945. An analysis of the diagnoses responsible for this shows that no single diagnosis group was especially accountable for the increase (Figure 70). The foremost group was cancer and other malignant tumors of the digestive tract and peritoneum with malignancies of the stomach and duodenum particularly prominent. The next in prominence was cancer of the uterus, with the proportion of cancer of the buccal cavity and pharynx also rather high. This general picture compares pretty closely with that of Kyoto, which was not severely bombed (Figure 70).

The conclusion seems justified, therefore, that to the extent that there is any increase in the proportion of hospital admissions for the care of malignant tumors in Tokyo following bombing, it is distributed rather evenly among the various types of tumors so that no particular type shows evidence of being especially affected. The slight increase in the proportion of admissions for this diagnosis in May for Osaka (Figure 69) was found to be due mainly to an increase in the field of nonmalignant and unspecified tumors (Figure 70) which in the absence of more specific information can be given no definite interpretation. The increase which is shown for Yokohama during May, the month of its most severe bombing, was also due mainly to an increase in nonmalignant tumors.

The increase for Nagoya in the latter half of the year following a very small number of admissions in June is also rather evenly distributed among the various diagnoses in much the same proportion that prevailed before the bombing. It seems, therefore, that the information available on hospital admissions for care of cancer and tumors during the bombing period for the cities studied shows only limited variations in the proportion of total admissions under this diagnosis. It also shows that these variations were not due to any outstanding change in the percentage of cases under any specific diagnosis except that for Yokohama and Osaka a somewhat disproportionate increase in admissions for care of nonmalignant tumors was shown during months when bombing was severe.

Diseases of the Genito-Urinary System

Hospital admissions for diseases of the

BOMBING EXPERIENCE AND HOSPITAL ADMISSIONS FOR NUTRITIONAL AND OTHER GENERAL DISEASES

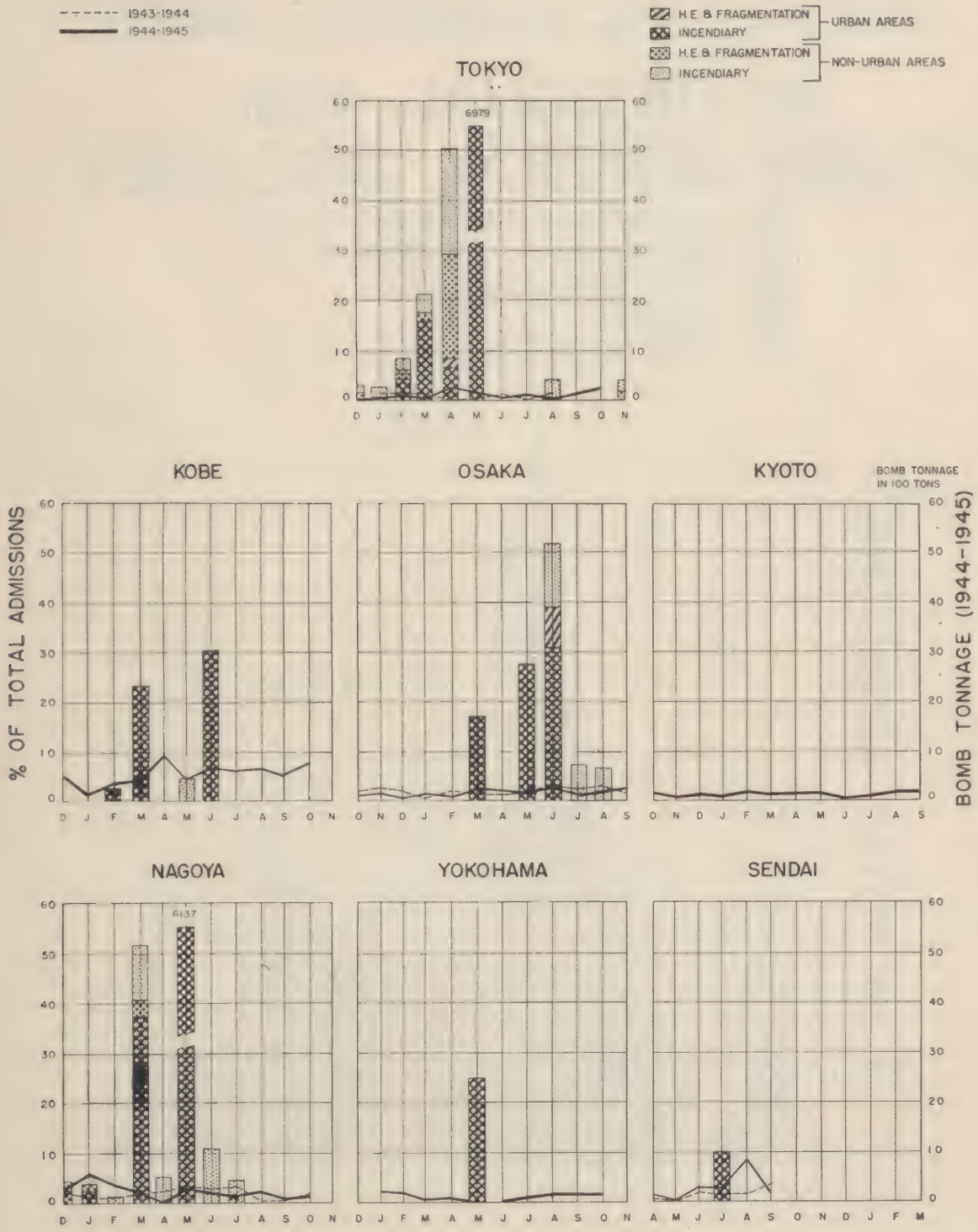


FIGURE 67

RELATIVE FREQUENCY OF HOSPITAL ADMISSIONS FOR SPECIFIC DIAGNOSES UNDER NUTRITIONAL AND OTHER GENERAL DISEASES

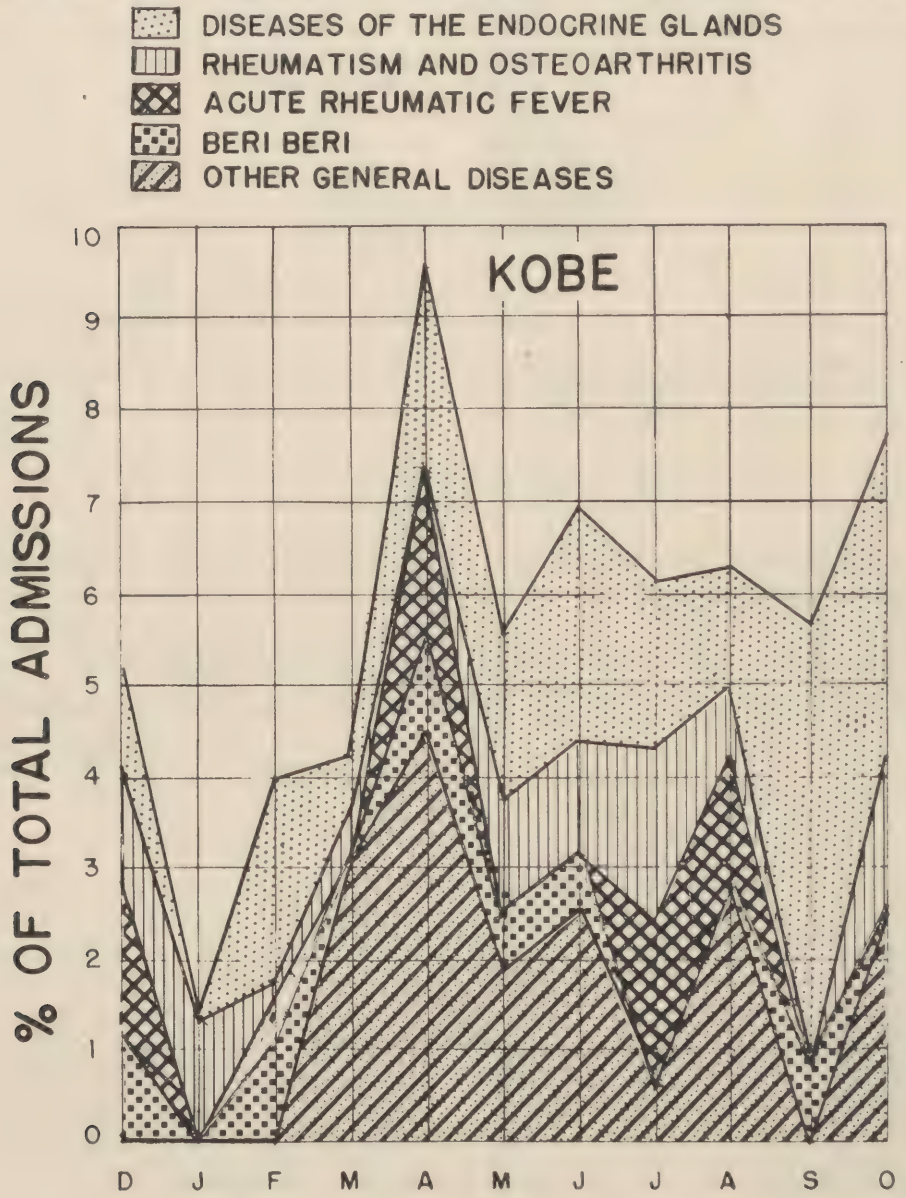


FIGURE 68

BOMBING EXPERIENCE AND HOSPITAL ADMISSIONS FOR CANCER AND TUMORS

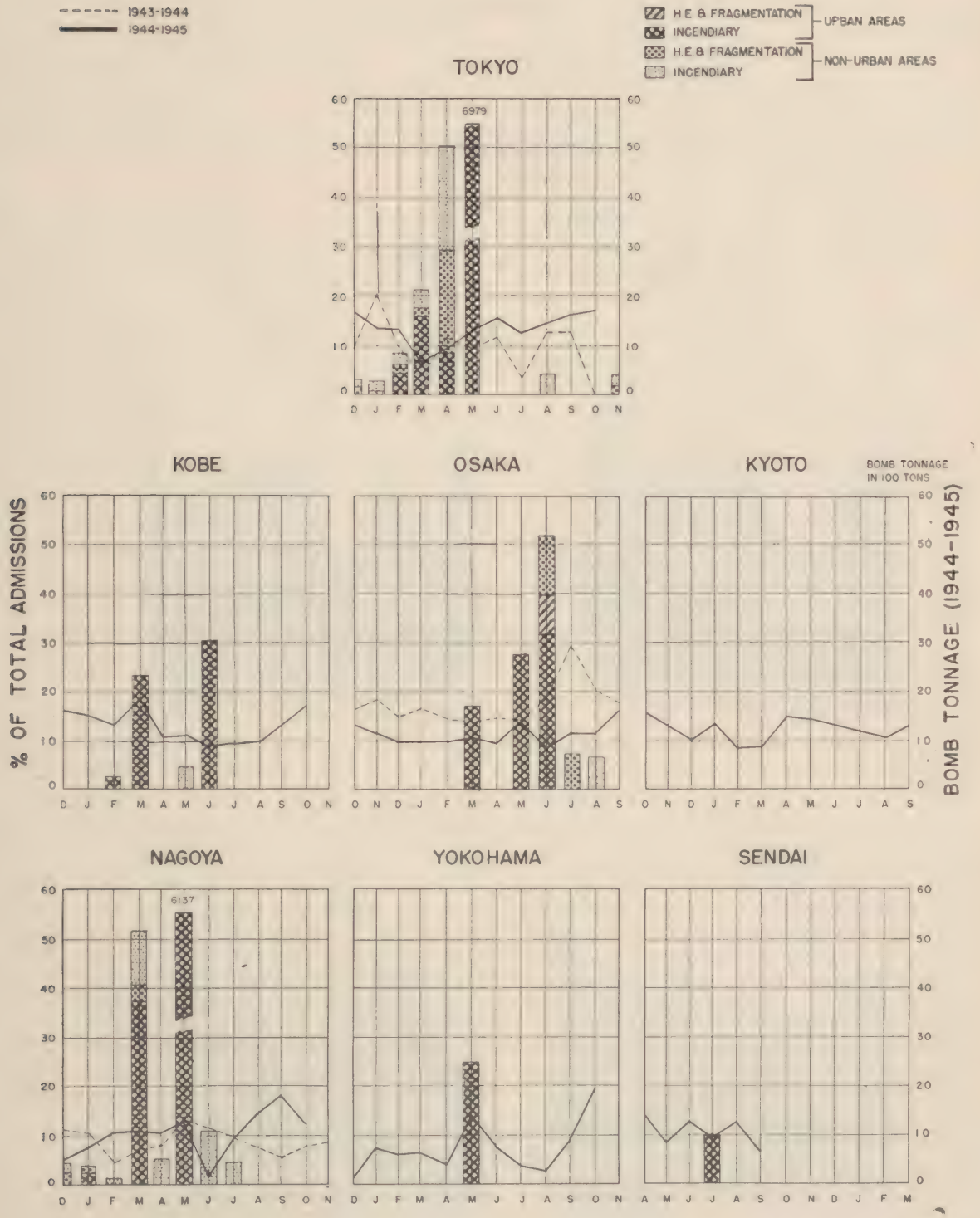


FIGURE 69

RELATIVE FREQUENCY OF HOSPITAL ADMISSIONS

FOR SPECIFIC DIAGNOSES UNDER

CANCER AND TUMORS

(1944-1945)

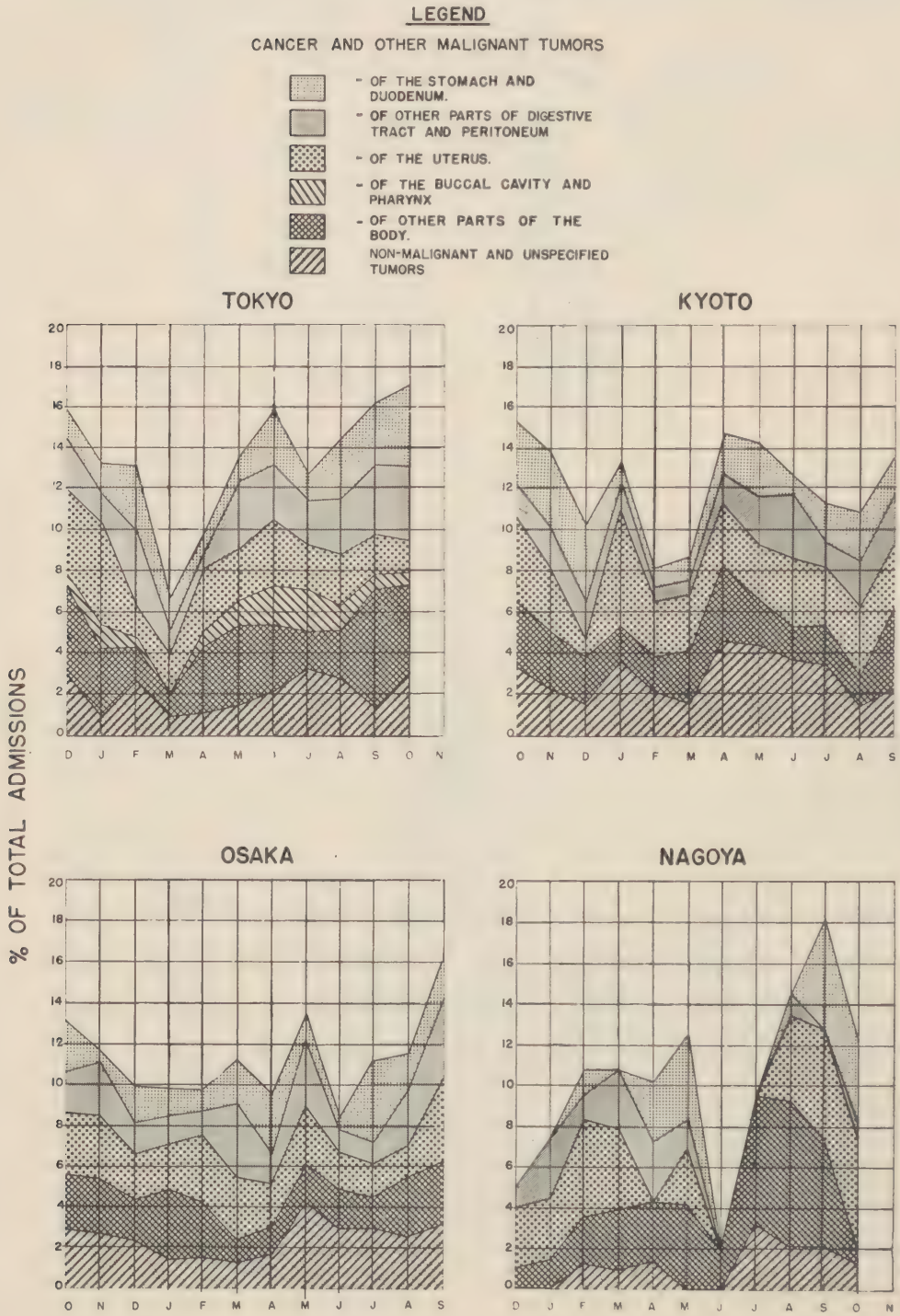


FIGURE 70

genito-urinary system were not outstanding during 1945 for any of the seven cities studied. They constituted a relatively constant proportion of the total admissions and for three of the four cities for which corresponding records for 1943–44 were available, the proportion of admissions which came under this diagnosis group in 1944–45 was lower than it was for 1943–44 (Figure 71). There does not seem to be any evidence from this study that bombing appreciably affected the rate of admissions to hospitals for care of genito-urinary diseases.

Diseases of Pregnancy and Childbirth

The record for conditions of pregnancy and childbirth is similar to that for genito-urinary diseases in that for all seven cities studied the proportion of hospital admissions for diagnoses falling in this category remained relatively constant throughout the year. For two of the four cities for which comparable information for 1944 is available the 1945 rates were lower than those for 1944 (Figure 72). For one of these two cities (Tokyo), the 1945 rates varied considerably less from month to month than they did in 1944. The record for Nagoya shows a rather pronounced rise in the rates for July and August. More detailed analysis of the Nagoya data for these months indicated that this rise was largely due to an increase in the number of admissions for abortion. The small number of cases included in the record of admissions for conditions of pregnancy and childbirth in Nagoya, however, renders this variation of doubtful significance.

A detailed analysis of admissions for diagnoses falling in this category for Osaka, where a larger sample is available, shows that in that city the proportion of these admissions for abortion remained relatively constant through the years as did also the proportion of admissions for toxemia of pregnancy (Figure 73). There does not seem to be significant evidence in these records that bombing caused any significant change in the proportion of hospital admissions for care of conditions of pregnancy and childbirth.

Other Diseases

The diagnosis categories already discussed cover well over 90 percent of the hospital admissions included in this study. The remaining admissions were for the following less frequent diagnoses: Diseases of the blood and blood-forming organs; chronic poisoning; congenital malformations; senility; diseases of early infancy and ill-defined diseases. A review of the relative frequency of admissions for these various diagnoses, considered as one group (Figure 74), indicates no significant changes in the month-to-month ratios for any city except possibly Nagoya. Nagoya admissions in this group showed a rather pronounced rise in August, September and October. More detailed analysis showed this increase to be mostly in the category of ill-defined diseases. This does not provide a satisfactory basis for any inferences with reference to changes in the diagnosis pattern of cases admitted to hospitals. It may indicate a decrease in the efficiency of diagnosis procedures under the stress of bombing and general wartime conditions, with the result that a larger proportion of cases failed to get diagnoses more definite than those falling in this "ill-defined" group.

In the absence of other evidences of changes from month to month in the ratios of hospital admissions for these diagnoses, it is considered that they do not provide evidence of change in ratios of hospital admissions for the diagnosis groups brought together here which would indicate appreciable alteration in health conditions as a result of bombing.

CASE FATALITY RATES

In addition to the information on hospital admissions, which has been considered above, the hospitals in six of the seven cities covered by this study also provided information on the deaths which occurred among their patients during the period under survey. This made available data from which it was possible to calculate case fatality rates among cases hospitalized in the selected hospitals for the survey period in 1944–45 in six cities and corresponding rates for 1943–44 in four of these cities.

The case fatality rates for the six cities averaged 13.13 deaths per 100 admissions in 1944–45 for all diagnoses (Table 147). For the different cities, the averages ranged from 7.93 for Kobe to 14.61 for Tokyo. For the various diagnosis groups the high rate for all six cities taken together was 23.81 deaths per 100 admissions for diseases of the nervous system.

BOMBING EXPERIENCE AND HOSPITAL ADMISSIONS FOR

DISEASES OF THE GENITO-URINARY SYSTEM

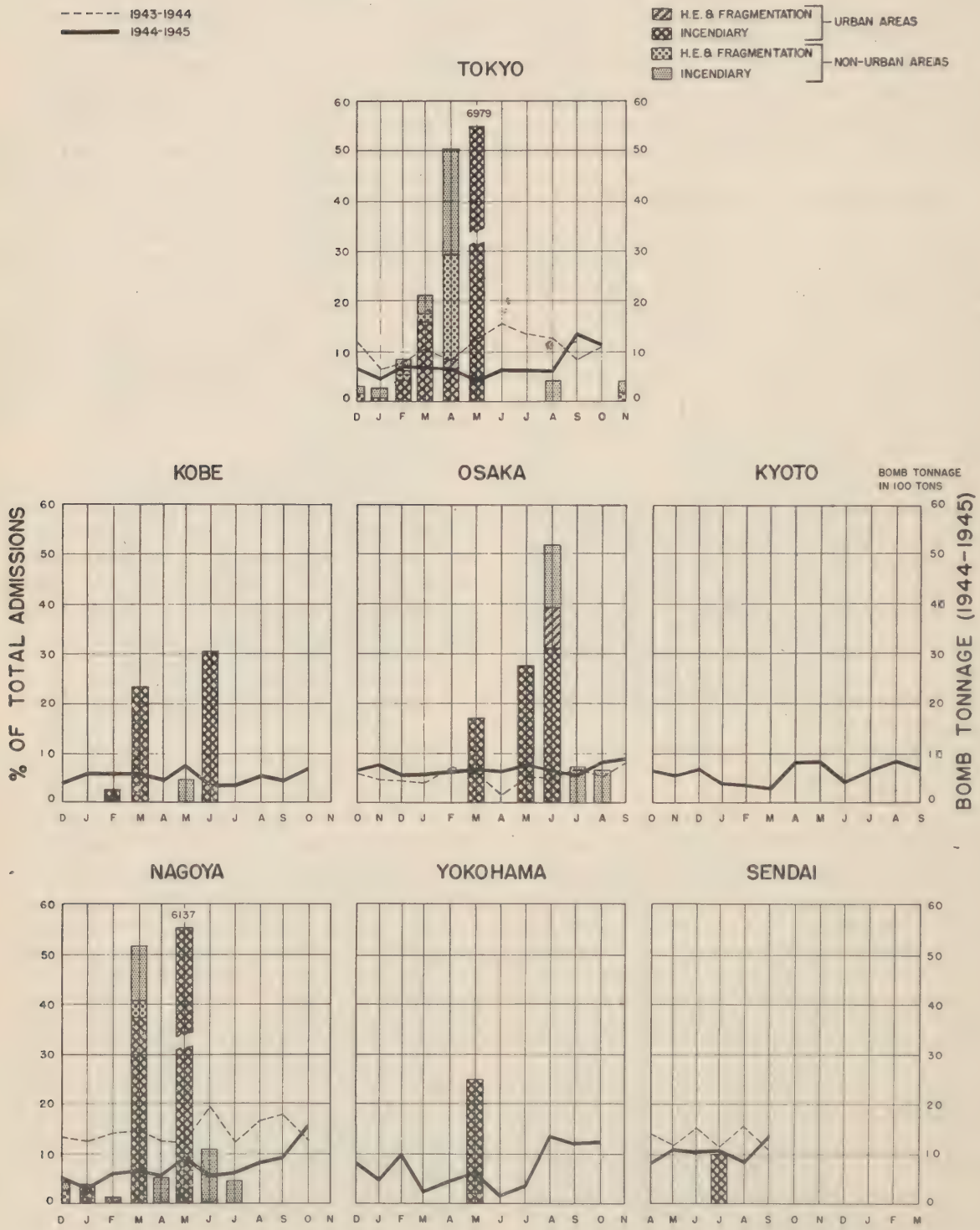


FIGURE 71

BOMBING EXPERIENCE AND HOSPITAL ADMISSIONS FOR DISEASES OF PREGNANCY AND CHILDBIRTH

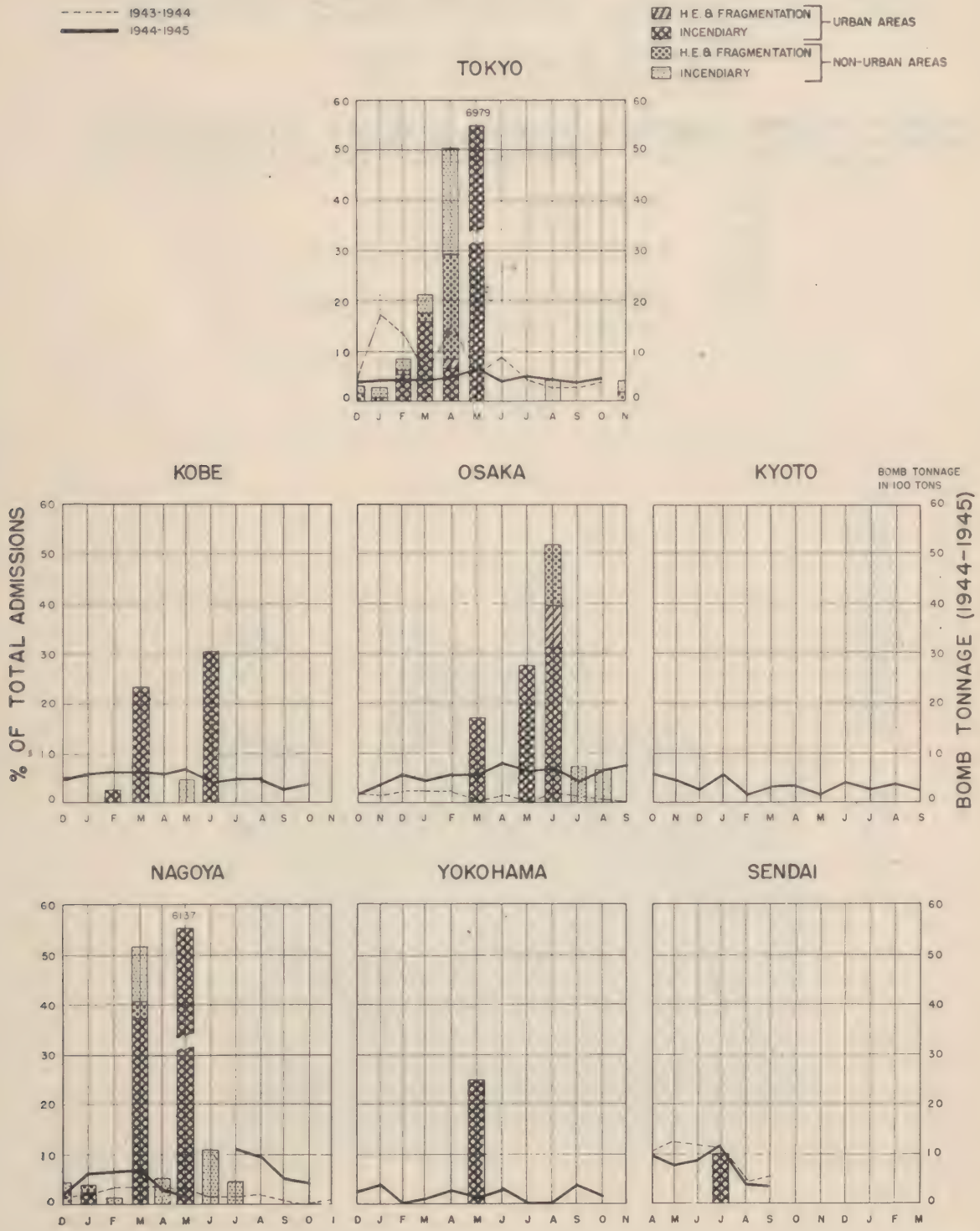


FIGURE 72

RELATIVE FREQUENCY OF HOSPITAL ADMISSIONS FOR SPECIFIC DIAGNOSES UNDER DISEASES OF PREGNANCY AND CHILDBIRTH

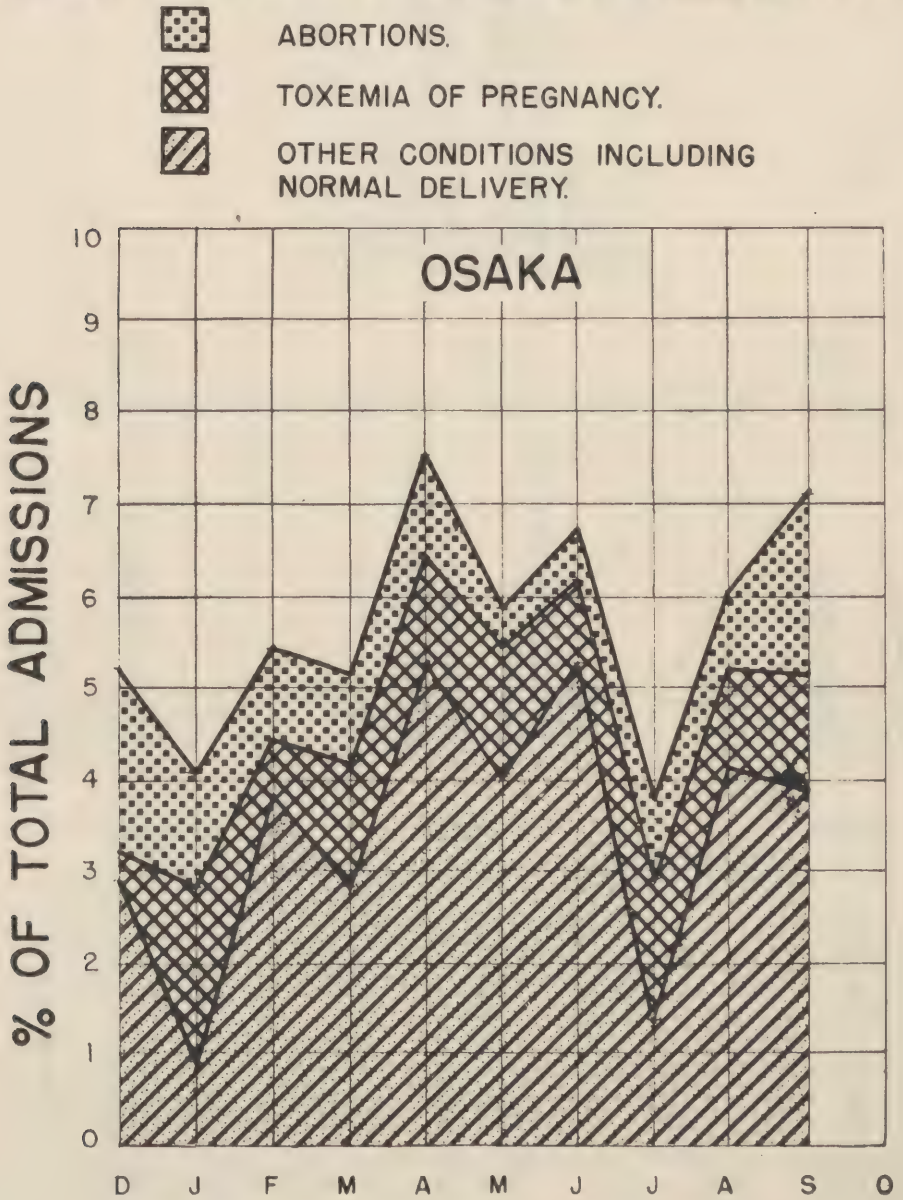


FIGURE 73

BOMBING EXPERIENCE AND HOSPITAL ADMISSIONS FOR VARIOUS INFREQUENT DIAGNOSES

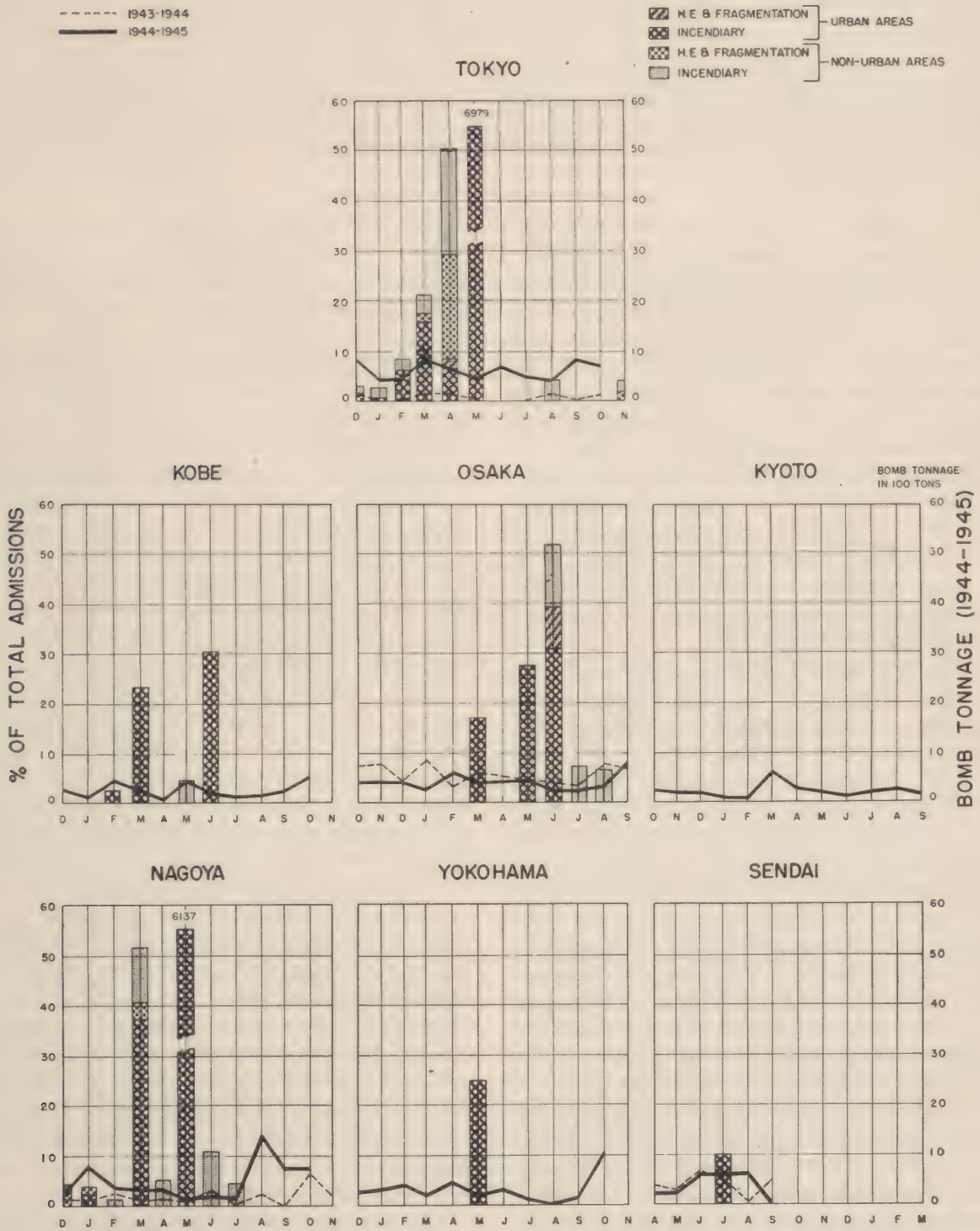


FIGURE 74

TABLE 147.—*Case fatality rates among hospital patients in Japanese cities (1944–45 versus 1943–44)*

Diagnoses	Number of deaths per 100 admissions							Percentage deviation from 1943–44 rates				
	Six cities	Tokyo	Osaka	Kyoto	Nagoya	Kobe	Yokohama	Four cities	Tokyo	Osaka	Kyoto	Nagoya
All diagnoses	13.13	14.61	14.26	12.94	7.94	7.93	13.79	26	19	9	85	49
Diseases of the digestive system	43.41	14.21	14.65	11.12	11.95	10.76	21.34	47	24	43	152	109
Diseases of the respiratory system	16.96	17.81	19.80	15.76	11.20	9.26	20.13	23	69	—4	—29	64
Diseases of the circulatory system	11.16	23.77	13.94	6.59	9.67	8.33	17.86	—24	(1)	—1	(1)	35
Diseases of the nervous system	23.81	17.93	20.73	34.43	14.92	11.86	13.16	62	—15	37	(1)	0
Diseases of the eye	.57	1.18	.41	0	.78	0	0	(1)	(1)	(1)	(1)	(1)
Diseases of the ear and mastoid process	3.66	1.60	5.09	4.96	3.44	4.44	.99	—9	—50	—27	(1)	65
Nutritional and other general diseases	7.71	9.52	13.39	5.95	4.76	2.04	9.09	—12	(1)	—10	(1)	96
Cancers and tumors	18.73	21.85	21.25	18.33	7.84	8.11	16.05	29	84	20	—81	24
Diseases of the genito-urinary system	8.92	12.32	10.88	5.94	5.40	3.23	4.55	24	67	15	(1)	15
Diseases of pregnancy and childbirth	3.39	1.91	4.89	4.10	2.08	0	5.26	—53	(1)	—73	—43	—56
Other diagnoses	17.13	17.92	18.05	24.31	4.08	6.52	5.71	—11	(1)	16	(1)	—16
Number of admissions	21,176	4,895	6,499	5,957	945	1,778	1,102					

[1] Reliable figures not available.

Among the rates for the individual cities, diseases of the nervous system stood highest for Kyoto and Nagoya, second for Osaka, and third for Tokyo. The rates for diseases of the digestive system stood highest for Yokohama and Kobe and second for Nagoya. It is of interest in this connection to note that these three cities are shown in the chapter on notifiable diseases to have experienced rather severe epidemics of dysentery and typhoid and paratyphoid fever. Yokohama also was shown earlier in this chapter to have had a high percentage of hospital admissions for diarrhea (Figure 56). These factors combine to emphasize the prominence of diseases of the digestive system in the morbidity picture of these cities.

Of possibly more significance for our purposes than these 1944–45 case fatality rates themselves is their comparison with corresponding rates for 1943–44. This comparison is possible for four of the six cities for which 1944–45 rates are shown and for these four cities it shows the striking increase of 26 percent in the number of cases terminating in death in 1944–45 over that for 1943–44 (Table 147). Each of the four cities showed an increase with the percentages ranging from 9 percent for Osaka to 85 percent for Kyoto. In the rates of the four cities taken together, increases were shown by five major diagnosis groups covering diseases of the digestive, respiratory, nervous and genito-urinary systems and cancer and tumors. The greatest increase (62 percent) is shown for diseases of the nervous system. It is significant that this is also the diagnosis group for which the six cities taken together showed the highest case fatality rate in 1944–45. The next highest increase (47 percent) is shown for diseases of the digestive system. Each of the four cities showed a marked increase for this diagnosis group, the rate for Kyoto and Nagoya being more than twice that for 1943–44.

In seeking the cause for this increase in the case fatality rate we are unfortunately unable to ascertain to what extent the case fatality rate for 1943–44 represents the normal rate for Japan. It is considerably higher than the corresponding rate for the United States. A comparable rate based on the experience of hospitals in the city of New York in 1933 was 5.6 deaths per 100 cases, which is approximately half of the 10.26 rate of four Japanese cities in 1943–44 and considerably less than half of the 13.13 rate for six Japanese cities in 1944–45. This suggests the possibility that the increase in case fatality rate which has been noted in 1944–45 over the rate for 1943–44 may have begun earlier than 1943. In this case it would be identified more closely with the general conditions resulting from the war than with the immediate situation in 1945, following the beginning of strategic bombing.

Undernourishment has been proposed by Japanese authorities as a prime cause of increased case fatality rates in general. The high rates of increase, particularly for digestive and respiratory diseases, would tend to support this theory. However, the fact that the most pronounced increase was in the field of diseases of the nervous system would indicate that other factors such as the stress of wartime conditions and particularly of bombing were also instrumental in producing this result.

Another factor was the increasing scarcity of medical personnel and facilities as the war

continued. The destruction of hospital facilities, equipment and supplies and the evacuation of physicians and nurses from bombed cities, also played a significant part in producing this situation. There were doubtless other causes contributing to this increase in case fatality rates among hospitalized cases, but the three which have been mentioned were prominent, and the extent to which they can be attributed to strategic bombing provides some indication of the part strategic bombing played in general in producing this increase in case fatality rates among hospitalized cases.

SUMMARY

The object of this study was to find significant changes, resulting from strategic bombing, in the general morbidity picture of Tokyo, Yokohama, Nagoya, Osaka, Kobe and Sendai. Kyoto, which was only slightly bombed, was also included in the study to aid in distinguishing between the general effects of the war and conditions more specifically caused by bombing. The proportional monthly distribution of diagnoses for which cases were admitted to representative general hospitals in the selected cities during the bombing period was used as the basis for discovering these changes. For purposes of the study, admissions for care of injuries and infectious diseases were omitted from the diagnosis groups studied for two reasons: Because many cases of these types received hospital care in other than general hospitals, rendering the general hospital records on them incomplete, and because these two types of cases are given separate consideration elsewhere in this report (Air-raid Casualties and Notifiable Diseases).

The diagnoses studied were divided into 11 groups. For none of these groups was the observed effect of bombing particularly pronounced. In no instance could a similar effect of bombing be traced in the records of all seven cities studied. In a number of cases it seemed that an outstanding effect of bombing was to accentuate tendencies already present.

A good example of this is found in the record of the effect of bombing on hospital admissions for care of diseases of the digestive system. The most severe bombing came at the beginning of the summer season when diseases of the digestive system normally increase in prevalence. Following the bombing, the increase in these diseases came in the cities observed just as it had in previous years. However, a comparison of the increase in 1945 in the presence of bombing with that for 1944 in the same cities indicated that for two of the cities for which this comparison was possible the 1945 increase was in excess of that for 1944. Two other cities also showed less marked increases in the proportion of admissions for digestive disorders in 1945. Diarrhea and enteritis stood foremost among the specific diagnoses responsible for this increase, with hernia and appendicitis also prominent for two of the cities.

Next in prominence to diseases of the digestive system among the diagnosis groups showing the effect of bombing was diseases of the nervous system. Among specific diagnoses in this group, dementia praecox and other psychoses stood foremost in one city and cerebral hemorrhage in another. The records of two psychiatric hospitals were also examined in this connection. One of them showed a marked increase in admissions in 1945. Both showed an increase over 1944 in the percentage of cases admitted for general paralysis of the insane and a decrease in the percentage of cases admitted for dementia praecox and other psychoses. A study also was made of suicides in the seven cities covered by the study. For five cities for which the 1944 rates were also available suicides were found to have increased from 11.7 per 100,000 persons in 1944 to 18.7 in 1945. The monthly rates for 1945 for the six cities for which they were available showed a tendency to rise as the year progressed, indicating a degree of correlation with the stress resulting from bombing and other war conditions.

In the category of diseases of the respiratory system there was evidence of an increase in the percentage of admissions for pleurisy, bronchitis and broncho-pneumonia in three cities.

Diseases of the eye were not unusually frequent among hospital admissions during the bombing period except in Nagoya. The increase in this city was rather marked but it was not matched by a similar increase in any of the other cities studied.

The record for Nagoya differed from that of most of the other cities also in showing an increase in the proportion of admissions for

diseases of the ear and mastoid process. This has been correlated with a bombing with high-explosive bombs which Nagoya experienced in June. Yokohama also showed a high percentage of diseases of this group but they were mainly before bombing of this city was begun and so cannot be attributed to bombing.

Study of the record on nutritional and general diseases shows some evidence of increase in the percentage of diseases of the endocrine glands in the records for Kobe. However, in view of the small number of cases involved, a question is raised as to the reliability of this observation.

Cancer and tumors showed some slight evidence of increase in prominence among hospital admissions in Tokyo following the bombing in 1945. When specific types of tumor were studied, the increase seemed to be pretty evenly distributed among all of them. In Osaka and Yokohama some evidence was found of an increase in the proportion of hospital admissions for care of nonmalignant tumors during or following their bombing periods.

For other disease groups, including diseases of the circulatory and genito-urinary system and diseases of pregnancy and childbirth, no evidence of increase in the proportion of hospital admissions was found.

Study of case fatality rates among admissions to hospitals in four of the cities studied showed a 26 percent increase in the proportion of deaths among hospital cases in 1945 over that for 1944. Among the diagnoses responsible for this increase, diseases of the nervous system stood first and diseases of the digestive system second. It is of interest to note that it was these two diagnosis groups which showed the most definite effects of bombing on the basis of increase in percentage of hospital admissions and other tests applied earlier in this study. This constitutes something of an accumulation of evidence that the effects on health of strategic bombing was particularly notable in the fields of these two diagnosis groups. Mention might also be made here of the prominence of epidemics of dysentery and typhoid and paratyphoid fever—both diseases of the digestive system—in the study of notifiable diseases. This further emphasizes diseases of the digestive system among those reflecting the effects of strategic bombing.

However, it is to be remembered, first, that these enteric diseases normally are unusually prevalent in Japan and, second, that these conditions which are considered effects of bombing represent intensifications of seasonal increases in disease which would have occurred, though probably to a less marked degree, in the absence of bombing. Therefore, while diseases of the digestive system would probably be prominent among the effects on health of bombing in general, it seems apparent that conditions peculiar to this immediate situation accentuated the effects noted in this study.

In conclusion, two general observations might be made: That general morbidity, exclusive of casualties resulting from bombing and infectious disease epidemics, was not markedly affected by bombing in Japan that bombing tended to have its most pronounced effect on health in fields where it accentuated tendencies already present rather than in producing effects which could be attributed wholly or mainly to bombing as their cause.

IX. TUBERCULOSIS

Tuberculosis, for many years the leading cause of death in Japan, has received an increasing amount of attention from health authorities and the medical profession during the last few decades. In 1919 the Law for the Prevention of Tuberculosis was enacted. This provided for physical examinations of those who because of their occupations were likely to acquire or spread the disease, and provided for the establishment of tuberculosis sanitoria and educational activities. Physicians were charged with the duty of instructing tuberculosis patients in methods of disinfection and other preventative measures, and the patients and their attendants were required to follow such instructions. Persons suffering from tuberculosis were prohibited from working in schools, hospitals, factories, inns, restaurants and barber shops.

RATES

Mortality and Case Incidence

Prior to the industrial expansion of Japan in the early 1930's, tuberculosis was on the decline. According to statistics for the years 1915–20, the average tuberculosis death rate was 231 per 100,000 for the whole country, but the average tuberculosis death rate of 361 per 100,000 for the forty-odd large cities was very much higher. At the same time the tuberculosis death rate in the villages approximately 150 per 100,000. As shown in Table 148, the mortality rates for tuberculosis in all Japan had declined to a level of 180 per 100,000 in 1932, with a total of 119,196 deaths. About this time, many rural inhabitants were brought into the cities to work in the various expanding industries, and the mortality rates from tuberculosis began to rise rapidly, with the result that by 1943 the rate for the whole country reached 225 per 100,000, with a total of 171,473 deaths. This represents an increase of 25 percent in tuberculosis mortality in 11 years. Meanwhile, during this period, the tuberculosis death rates in the United States were steadily declining from 85.5 per 100,000 in 1926 to 41.3 per 100,000 in 1944, a reduction of 57 percent. By 1943, the last year for which complete Japanese statistics are available, the rate of 225 per 100,000 for Japan was more than five times the rate of 42.6 for the United States.

TABLE 148.—*Total deaths and tuberculosis deaths and rates, all Japan, 1926–43*

Year	Actual number of deaths		Deaths per 100,000 population		U. S. tuberculosis rates
	Total	Tuberculosis	Total	Tuberculosis	
1926	1,160,734	113,045	1,911.7	187	85.5
1927	1,214,325	119,439	1,968.8	195	79.6
1928	1,236,711	119,635	1,974.6	192	78.3
1929	1,261,228	123,490	1,984.2	197	73.3
1930	1,170,867	119,635	1,816.7	186	71.1
1931	1,240,891	121,875	1,898.2	186	67.8
1932	1,175,344	119,196	1,773.2	180	62.5
1933	1,193,987	126,703	1,772.6	188	59.6
1934	1,234,684	131,524	1,808.5	193	56.7
1935	1,161,936	132,151	1,677.8	191	55.1
1936	1,230,278	145,160	1,750.8	207	55.9
1937	1,207,899	144,620	1,696.3	203	53.8
1938	1,259,805	148,827	1,748.2	206	49.1
1939	1,268,760	154,371	1,741.0	212	47.1
1940	1,186,595	153,154	1,622.9	210	45.9
1941	1,149,559	154,344	1,579.3	209	44.5
1942	1,166,630	161,484	1,553.2	215	43.1
1943	1,219,015	171,473	1,601.7	225	42.6

Attempts to Reduce Incidence

The Japanese government officials were so concerned by this alarming increase in tuberculosis that in 1938 the Konoye Cabinet created the Ministry of Health and Social Affairs to remove health matters from the Bureau of Home Affairs. This ministry planned and began the erection of a number of national sanitoria for the treatment of additional tuberculosis cases, and the leading antituberculosis societies intensified their activities. For example, by 1945, The Japanese Treatment Corporation was employing 806 physicians in 74 sanatoria and 122 preventoria. Despite the wartime restrictions on construction, additional facilities were made available for tuberculosis patients so that by 1945 the total capacity of all tuberculosis hospitals had increased threefold over that for 1940.

TABLE 149.—*Number of hospitals and bed capacity for tuberculosis cases, 1938–45*

Year	Number of hospitals	Bed capacity
1938	153	14,138
1939	185	18,671
1940	195	21,446
1945	328	68,214

Physical examinations, besides those provided for by the Law for the Prevention of

Tuberculosis, for those whose occupations make them susceptible to this disease, were made under the provisions of the Factory Act, the Law for the Control of Physique and for health insurance purposes. All these group examinations revealed a high incidence of tuberculosis, especially when X-ray films were used. Table 150 shows the prevalence of tuberculosis among personnel of eight central government offices in 1944.

TABLE 150.—*Tuberculosis cases among the personnel of the central government offices found by routine medical examinations (1944)*

Group	Sex	Number of personnel examined	Number of patients	Percent
The Imperial Household Department.	Male	2,567	52	2.0
	Female	600	10	1.7
	Both sexes	3,167	62	2.0
The Cabinet	Male	1,719	58	3.3
	Female	1,290	31	2.4
	Both sexes	3,009	89	2.9
The Ministry of Foreign Affairs.	Male	407	15	3.2
	Female	263	6	1.8
	Both sexes	670	21	2.3
The Ministry of Home Affairs.	Male	768	90	11.7
	Female	341	15	4.4
	Both sexes	1,109	105	9.5
The Ministry of Justice	Male	319	16	3.7
	Female	186	2	
	Both sexes	505	18	3.6
The Ministry of Health and Social Affairs.	Male	704	42	6.0
	Female	873	20	2.3
	Both sexes	1,577	62	3.9
The Ministry of Agriculture	Male	1,076	36	3.3
	Female	740	10	1.4
	Both sexes	1,816	46	2.5
The Ministry of Munitions	Male	1,296	19	1.5
	Female	948	15	1.6
	Both sexes	2,244	34	1.5
TOTAL	Male	8,856	328	3.7
	Female	5,241	109	2.1
	Both sexes	14,097	437	3.1

Of the 14,097 employees examined, 3.1 percent were found to have evidence of tuberculosis, the rates being 3.7 percent for males and 2.1 percent for females. Many of the employees in these agencies had undergone previous examinations, and those with infectious tuberculosis were dismissed; otherwise the rates would have been higher. In the Ministry of Home Affairs, for example, where previous examinations had not been made, 11.7 percent of males and 4.4 percent of females had tuberculosis. Even in the Ministry of Health and Social Affairs, 6.0 percent of the males and 2.3 percent of the females had tuberculosis.

In March 1945, a special survey was made of 16,890 industrial workers who had been absent from their work for more than 14 days because of illness. These examinations were made in 660 health centers throughout Japan which had the services of physicians, nurses, supporting personnel and X-ray equipment. The results of these examinations with regard to fitness for work is as follows:

Number of examined persons	16,890	
Number of persons who were deemed to be able to work without rest	6,469	(38.3%)
Number of persons who were deemed to be necessary to take rest for a while	8,506	(50.4%)
Number of persons who were deemed to be unable to return to their work	1,915	(11.3%)

Active, open tuberculosis accounted for about two-thirds of the 1,915 persons or 11.3 percent of those found unfit for work. Inactive or active-closed tuberculosis accounted for about two-thirds of the 8,506 persons or 50.4 percent of those required to undergo further rest and treatment before returning to work. Only 6,469 workers or 38.3 percent of the groups examined were able to return to work. Thus, tuberculosis accounted for a very large proportion of all prolonged illnesses among industrial workers in the spring of 1945.

TABLE 151.—*Tuberculosis death rate per 100,000 population by age and sex (1943)*

Age (years)	Both sexes	Male	Female
0–4		73.9	67.1
5–9	37.0	34.0	40.0
10–14	78.8	58.5	117.6
15–19	438.1	431.9	444.4
20–24	491.1	529.6	451.9
25–29	416.0	467.6	364.5
30–34	309.8	355.9	263.5
35–39	243.3	288.5	195.9
40–44	207.4	250.8	161.3
45–49	191.7	236.9	143.8
50–54	202.2	236.7	146.2
55–59	191.7	252.9	132.7
Over 59	132.5	192.5	85.3

Relation to Age and Sex

Table 151 shows the tuberculosis death rates by sex and 5-year age groupings for 1945. The peak rates of 438, 491 and 416 per 100,000 for both sexes, occurred in the age groups 15–19, 20–24 and 25–29 years, respectively. For males, the rate of 530 per 100,000 in the 20–24 year group is considerably higher than any other age group. For females, the rates of 444 and

452 for the 15–19 and 20–24 year age groups are much greater than any other age groups. The female death rates are slightly higher than the male among those under 20 years of age, but after 20 years of age the male rates are considerably higher. In both sexes the rates are relatively low for persons under 15 and over 59 years of age.

TABLE 152.—*Actual number of tuberculosis deaths by age groups (1902–43)*

Year	Age group				
	0–14	15–29	30–44	45–59	Over 59
1902	15,194	33,854	16,314	11,924	5,277
1911	22,288	48,736	22,178	13,717	6,929
1926	15,692	59,234	20,913	12,074	5,113
1933	15,143	69,090	24,575	12,696	5,095
1938	17,952	84,168	27,893	13,263	5,551
1940	16,845	87,174	29,417	13,424	6,294
1943	17,289	92,477	36,305	17,471	7,931

The actual number of tuberculosis deaths for 15-year age groupings for selected years from 1902 through 1943 is shown in Table 152. It indicates that the number of deaths in the 15–29 year age group increased almost threefold; in the 30–44 year age group, over twofold. In the over 44-year and under 15-year age groups, there was a moderate rise in deaths. It was stated that the age groupings remained rather stable in proportion to each other during this time despite an over-all increase in population.

The Ministry of Health also supplied data showing the incidence of pulmonary tuberculosis found by physical and X-ray examinations of young men 15–19 years of age in 1942 and 1943. Those examinations, made under the Law for the Control of Physique, showed the percentage prevalence of tuberculosis as follows:

Year	Age group				
	15	16	17	18	19
1942	1.83	2.28	3.08	3.55	3.98
1943	1.84	2.28	2.95	3.68	4.20

It may be noted that for both years the prevalence of tuberculosis was greater among the older boys, being about twice as great among the 19-year age group as the 15-year age group.

It is apparent therefore, that the greatest mortality and increase in mortality from tuberculosis in Japan among both sexes occurs at ages which comprise the height of productivity. Japanese health officials stated that this fact was because in Japan disabling tuberculosis almost always develops directly after the primary or initial infection. In addition to the unfavorable factors of malnutrition and crowding, many of these young men and women recently had been drawn into heavy war industries and tuberculosis rates in Japan had closely paralleled industrial activity.

NON-PULMONARY FORMS

Of outstanding interest is the large proportion of tuberculosis of organs other than the lungs. This fact suggests that the bovine type of tubercle bacillus is a much more common source of infection in Japan than in the United States. For example, in 1930, pulmonary tuberculosis accounted for only 72.2 percent of all tuberculosis deaths in Japan, whereas during the same year pulmonary tuberculosis accounted for 91.0 percent of all tuberculosis deaths in the United States. The leading causes of death from non-pulmonary tuberculosis in Japan were: abdominal—26,395 deaths; meningeal—8,734 deaths; spinal—2,770 deaths; genital—1,053 deaths; military—700 deaths; and bones and joints—665 deaths. In children less than 10 years of age nonpulmonary deaths occurred about twice as frequently as pulmonary deaths. In the 10–14 year age group, nonpulmonary tuberculosis deaths were not quite as frequent, whereas in persons over 15 years of age, the pulmonary type greatly predominated. The apparent widespread prevalence of bovine-type tuberculosis in Japan should give rise to further consideration of the epidemiology and control of this type of infection.

WAR TRENDS

National health insurance data indicated that illness claims because of pulmonary tuberculosis rose rapidly from 13.6 per 1,000 insured persons in 1933 to 43.7 per 1,000 in 1941. The claim rates declined slightly to 43.1 per 1,000 in 1942, and to 40.7 per 1,000 in 1943 but were still much higher than the rates of 25.1 and 29.1 for 1939 and 1940. The slight drop in

insurance claims in 1942–43, despite a nationwide increase in tuberculosis, was attributed to the fact that many workers, with more money than formerly, were visiting private physicians rather than the insurance doctors.

Tuberculosis statistics gathered locally during the survey indicated that tuberculosis was the outstanding health problem in representative urban industrial centers. In Osaka city, the death rates from tuberculosis had increased from 200 to 290 per 100,000 from 1920 to 1942, with considerable annual fluctuations. Pulmonary tuberculosis alone varied from 140 to 210 deaths per 100,000 inhabitants. The health officer stated that these rates for tuberculosis were minimal, as a sizeable number of fulminating cases of pulmonary tuberculosis had been classified as "pneumonia," the leading cause of death in that city. Mass tuberculin and X-ray examinations performed in schools and universities in the prefecture indicated 10,227 persons or 4.1 percent of the 251,773 examined had evidence of pulmonary tuberculosis. About 4,000 of these cases, or 1.6 percent of those examined, had active pulmonary tuberculosis. The highest rate of 7.0 percent was for teachers and school staffs. The lowest rate of 1.5 percent was for children in the primary schools. Few examinations were made in 1945 because of the air raids, but those made indicated an increase in rates. At the time of the survey a meeting between health officials, interested agencies and physicians was in progress to study means for controlling tuberculosis.

In Kyoto prefecture, health officials stated that there were about 50,000 known tuberculosis patients and approximately 5,000 of these were dying annually. The average tuberculosis mortality rate in recent years had been about 230 per 100,000 but the rates had undoubtedly increased sharply since the last available statistics in 1943 because of malnutrition.

TREATMENT AND PREVENTION

There had been no general campaign against tuberculosis in Kyoto prefecture. Persons closely associated with known patients were required to undergo X-ray examinations. Patients with open tuberculosis were required to go to sanatoria. All factory workers and school children were supposed to undergo tuberculin tests and the negative reactors were given BCG injections by their physicians. The positive reactors received further examinations for evidence of tuberculosis.

In Nagoya City, prefectural health officials stated that the annual tuberculosis mortality rates per 100,000 were as follows:

Nagoya, 1940–1944 (per 100,000)

1940	230
1941	225
1942	216
1943	272
1944	300

Here as elsewhere there was a marked rise in tuberculosis deaths during 1943–44.

In addition to the many attempts at tuberculosis case-finding by means of tuberculin tests supplemented by X-ray examinations and blood sedimentation rates on positive reactions, efforts were being made to protect the tuberculin-negative and presumably susceptible examinees with BCG vaccine (an attenuated or modified culture of bovine tubercle bacilli). According to Ministry of Health officials, there was good reason to believe this was a sound procedure and its general use had been advocated for the past 3 years, after 3 years of experimentation. They felt the program was very effective and planned to expand it throughout the country. Table 153 shows the results of the collection of data on annual tuberculosis rates for 4 years, obtained from one large experiment on two groups of tuberculin-negative children the same age, one group vaccinated and the other being used as a control group.

TABLE 153.—*Relation between BCG vaccination and incidence of tuberculosis*

	Children	
	Vaccinated	Not vaccinated
Number in group	55,219	33,066
Percent developing tuberculosis	0.67	3.51
Percent dying from tuberculosis	.02	.18

These data showed that tuberculosis developed more than five times as frequently in the nonvaccinated children as in vaccinated children, and the tuberculosis death rate was nine times as high in the nonvaccinated group. It is not known how well this experiment was conducted and controlled, but the results are similar to

those of a well-controlled study made in the United States which is reported in the Public Health Reports for 7 June 1946.

A similar experiment on a smaller scale was conducted in 1939–40 at the Nakajima Aircraft Company plant near Tokyo. Among tuberculin-negative boys of 15 to 20 years of age, one group of 337 was vaccinated subcutaneously with 0.005 milligrams BCG and another group of 447 served as a control. Of those vaccinated, 2.9 percent developed tuberculosis within two years, whereas 12.3 percent or four times as many of the unvaccinated group developed tuberculosis during that time. Following this work, the medical director began giving all tuberculin-negative employees one intracutaneous injection of 0.1 to 0.6 milligrams BCG and stated this procedure had accomplished a great deal in controlling tuberculosis in the plant, in conjunction with the careful examination of new employees and the rejection of those with tuberculosis.

Dr. T. Tamiya, Dean of the Medical Faculty of Tokyo Imperial University and Director of the Institute of Infectious Diseases, discussed the tuberculosis problem at some length. He stated that tuberculosis had been extremely serious before the war with a death rate of 200 per 100,000 population and had increased during the war. It was too soon after the air raids to determine any measurable effects, but the prevalence was undoubtedly increasing. He also stated that he had learned that cases of early tuberculosis showed no tendency to improve so that the case fatality rate had doubled or even tripled from the rate of 10 percent in 1943. He was the only Japanese health official interviewed who doubted the efficacy of BCG vaccine and believed that this doubtful procedure was overshadowing the usual and more important means of control which had been successful in western nations. He felt that the technique of the tuberculin test and interpretations done by unskilled people were not as accurate as they should be and that it was doubtful that previous experiments had been properly controlled. He also pointed out that the United States, by common-sense control measures, had reduced its rates to a far greater extent than the rate reduction the Japanese claimed for BCG.

EFFECTS OF BOMBING

All outstanding health officials interviewed stressed that the gravity of the tuberculosis problem had been greatly aggravated by the air raids because of increased malnutrition, overcrowding, dispersal of infectious cases and a break-down in the tuberculosis control program. The chief of the division responsible for tuberculosis control in the Ministry of Health pointed out that malnutrition and the return to rural areas of infectious cases among demobilized soldiers and industrial workers were the two most important factors in the spread of the disease. He was attempting to set up special control measures in cooperation with the local health centers throughout the country. These involved the greater use of mass tuberculin and X-ray tests, BCG vaccine, consultation services and the isolation of infectious cases. The shortage of food in tuberculosis sanatoria was a difficult problem which caused many infectious cases to leave the sanatoria. Unsuccessful attempts had been made to obtain additional supplies from the Ministry of Agriculture. Until the food problem could be solved and additional sanitoria provided it was unlikely that a large proportion of infectious tuberculosis cases could be isolated and properly treated.

SUMMARY

A campaign to control the major health problem of Japan, tuberculosis, had been carried on during the prewar years and to a limited extent during the war. Many physical and X-ray examinations were made of industrial workers, students and young adult males to uncover and treat active cases of tuberculosis. To attempt immunization of tuberculin-negative persons, BCG vaccine was inoculated and thought to be of value. Despite this program, the industrial expansion, the wartime influences of crowding and malnutrition, and the deterioration of public health and medical services resulted in an all-time peak of 171,474 deaths from tuberculosis in Japan for 1943. This last year, 1943, for which complete data are available had a rate of 225 tuberculosis deaths per 100,000 population as compared to the lowest reported rate of 180 per 100,000 in 1932, an increase of 25 percent. This rate is over five times that of 43 per

100,000 for the United States for the same year. In addition there had been a substantial increase of tuberculosis in 1944 and 1945. Cases of early tuberculosis had shown little tendency to improve during these past two years and the average fatality rate of 10 percent of all cases had increased two or threefold.

It was too early to expect any measurable effects of the air raids upon this most important health problem at the time of this survey. As repeated exposure to active cases, prolonged malnutrition, fatigue, lack of shelter and clothing, and crowding are commonly recognized factors in the spread of tuberculosis, it is probable that records would show a serious increase in its prevalence. It remains to be seen how effectively the United States and Japanese health officials can control the spread of this disease.

X. VENEREAL DISEASES

BACKGROUND

The problem of venereal diseases in Japan generally has been unappreciated and neglected. Despite active campaigns against tuberculosis and for promoting the "national strength," little or no emphasis has been placed on the case-finding and treatment of syphilis. Still less attention has been given to gonorrhea. The educational activities on this subject likewise have been extremely limited.

Venereal disease problems have been closely related to commercialized prostitution which in Japan was an accepted and legalized institution operating under the direct control of the police. The present system of licensed prostitution dates from 1881 when the Metropolitan Police Board of Tokyo required prostitutes to live in brothels and required their compulsory examination, so that venereal diseases could be more easily controlled. In 1900 the Prostitution Law was enacted. It provided for the licensing, examination and free treatment of all infected prostitutes. By 1938 there were 233 venereal disease clinics engaged in the diagnosis and treatment of persons whose occupations were likely to spread venereal disease. During that year these clinics treated 557 cases of syphilis, 1,279 cases of gonorrhea and 1,470 cases of chancroid. The 1938 annual report of the Ministry of Health and Social Affairs reported at that time that there were 42,624 licensed prostitutes (Joro or Shogi) in 377 brothels. There were 135 hospitals or treatment centers available for infected prostitutes, who were admitted an average of 1.74 times during that year. For the routine examination of prostitutes there were 348 health-examination stations. The law was amended to include reporting of venereal diseases, quarantine, hospitalization and payment of medical expenses.

In addition to the licensed prostitutes, there were many private prostitutes who customarily lived two to a small house which was termed a "private eating and drinking establishment." These prostitutes were recognized and controlled by the police. Clandestine prostitution was common among waitresses, hotel maids and low-class Geisha, especially in rural districts.

Before the war-induced inflation and the occupation by the United States forces Geisha were highly skilled and talented entertainers who did not engage in prostitution, but these two influences have largely reduced them to prostitution. In addition, large numbers of factory and farm girls have been recruited as Geisha to supply the increasing demand since the occupation. Recently, the only major distinction between these low-class Geisha and licensed prostitutes was that the fee of 40 yen for the former was greater than that of 30 yen for the latter.

In 1943 the government ordered all Geisha houses and other places of entertainment closed and these were not reopened until after the surrender. The girls were supposed to go to work in factories but many began clandestine prostitution. The licensed prostitutes were permitted to carry on in several localities including Tokyo, however, as a "safety valve for the poor man." After the war all remaining brothels and Geisha houses quickly resumed business on a large scale.

PREVALENCE IN JAPAN

All available data indicate that the incidence of syphilis in Japan is about 10 percent among the adult population. In 1935 a random survey of 1,000 persons in Osaka, including city employees, students, factory workers and hospital patients, showed blood reactions indicative of syphilis in 10 percent. The municipal employees in this group had rates of five percent. The city health officer stated that there had been a definite increase in syphilis and gonorrhea during the war because the increased factory wages resulted in more money for recreation and there were larger numbers of girls in the factories. The hospital for venereal diseases was operating at its capacity of about 300 beds. It was stated that about 50 percent of the Osaka prostitutes were infected and many brothel owners required the girls to continue business while undergoing treatment. The "walled city" containing 1,500 to 2,000 prostitutes was not "off limits" at the time of this survey. Two of the six segregated areas were burnt out. Free blood tests and public talks on syphilis along with

other communicable diseases were given during the Osaka "health week" in May.

In Kyoto, fairly recent blood tests of 5,000 male factory workers in war industries indicated that the incidence of syphilis was 16 percent. The prefectural health officer stated that examinations of prostitutes revealed 60 percent had syphilis and 80 percent had gonorrhea. The Geisha ranged from relatively low rates up to those for prostitutes, depending on the level tested. Information from Sixth Army Headquarters indicated that in 500 examinations among 1,500 registered prostitutes, 85 percent had syphilis. In addition, there were about 2,000 clandestine prostitutes. The United States Army was examining all prostitutes and sending infected cases to the hospital. In Kyoto, the girls were required to wear a number for ready identification and infected soldiers were required to report the number to insure apprehension and treatment.

In Nagasaki, examinations of 337 prostitutes by United States Military Government officials showed 80 percent had syphilis. Gonorrhea rates in different groups ranged from 20 to 100 percent, depending somewhat on the thoroughness of the examinations. Thirty percent of 500 injured hospital patients examined gave positive Kahn tests, however, this rate of incidence seemed unduly high to be representative of the adult population in aggregate. The Japanese officials there estimated that seven percent of the adults had syphilis, but according to AMG officials this rate should be higher. In addition to the licensed prostitutes there were about 200 clandestine prostitutes. The AMG had made plans for the hospitalization and treatment of all girls they found to be infected.

In Kobe, recent examinations of 858 prostitutes revealed that 120 had syphilis, 150 had gonorrhea, 40 had chancroid and 5 had multiple infections.

Officials of the Ministry of Health stated that since 1938 they have obtained no data on the prevalence of venereal diseases. A blood-testing survey of industrial workers in Osaka made in 1937 showed that 12.2 percent of 5,176 males, 13.2 percent of 1,022 females and 10.5 percent of 416 office workers had syphilis. Of persons visiting a general dispensary in Tokyo, 11.2 percent of 881 males and 12.4 percent of 889 females had syphilis. All the villagers of Naruse, Saga prefecture, were blood tested and 5.8 percent showed evidence of syphilis. In a nearby factory 9.8 percent of 1,484 employees had positive reactions. These officials stated that about 10 percent of the adult population in Japan had syphilis.

Tests were positive on 63 percent of 2,702 prostitutes examined in the Tokyo Yoshiwara district in 1937. That same year another study of the prevalence of syphilis according to the length of time in prostitution gave further enlightenment on the problem (Table 154).

TABLE 154.—*Prevalence of syphilis among prostitutes, Tokyo, 1937*

	0–3 months (percent)	4–6 months (percent)	7–12 months (percent)
Licensed prostitutes	40	55	58
Private prostitutes	15	47	52

These officials also stated that during the first half of the war there was increased prostitution because of inflation and other wartime conditions, with a subsequent rise in venereal disease rates, but since the government restrictions were put into effect in 943 they had no control over this problem. As many prostitutes continued their trade on a clandestine basis, venereal disease rates were undoubtedly increasing. Now, many girls were returning from the factories and resuming their trade and many Geisha, waitresses, and hotel girls were resorting to prostitution because of economic conditions. A new and more stringent law was being planned to control prostitution and additional venereal disease clinics were to be established.

Officials of the Tokyo Municipal Health Department stated that a special survey of 1,000 middle-class persons visiting tuberculosis clinics in 1940 indicated that 10 percent had syphilis. They believed that the syphilitic rate for the total adult population would be between 5 and 10 percent. Before the war, prostitutes in Tokyo numbered about 15,000 but now were reduced to about 1,600. Blood tests were now being made on a monthly basis and weekly physical examinations were made, including smears for microscopic examination. Of 525 blood tests made in November 1945, 25 percent were positive for syphilis. Here again, wartime and air-raid influences on venereal disease could not be ascer-

tained because of the wartime restrictions on prostitution.

A survey of venereal disease conditions on Honshu with regard to United States Army control of venereal diseases, was reported as of 15 November 1945 by Lt. Col. Wayne W. C. Sims, M.C. Since the arrival of troops in Japan the venereal disase rate had increased from 80 per 1,000 per annum for the first 2 weeks of October to 170 per 1,000 per annum by the last week in October for the Sixth Army, and to 176 and 200 respectively, per 1,000 per annum for two divisions of that army. In the Eighth Army sector, where brothels were "off-limits," the September rate of 28 per 1,000 per annum had increased to 44 per 1,000 by October. He pointed out the number of prostitutes and the segregated districts in key areas (Table 155).

TABLE 155.—*Numbers of prostitutes and segregated districts in selected areas*

Area	Number of districts	Number of prostitutes
Tokyo	26	1,302
Yokohama	12	547
Kanagawa prefecture	16	526
Kyoto	8	1,016
Osaka	5	6,000
Kobe	4	900

Spot checks on the daily number of troops patronizing these houses in one district in Osaka and three districts in Kyoto were obtained from prophylactic station records (Table 156).

TABLE 156.—*Use of prophylactics and houses of prostitution by troops*

Area	Number of days recorded	Number of prophylactics per day	Number men per day
Osaka	16	535–1,288	1,216–2,530
Kyoto, 1	14	63– 119	294– 594
Kyoto, 2	16	31– 123	259– 455
Kyoto, 3	16	45– 86	191– 301

DIAGNOSTIC METHODS

The inadequacy of the Japanese routine examinations was shown by the fact that during the preceding 8 months only 10 cases of syphilis had been diagnosed among these prostitutes.

The routine examination of prostitutes was done on a production line basis with a hurried inspection of the vagina and cervix. Smears or cultures for gonorrhea were not made in the Kyoto area but were made to some extent in Tokyo and Yokohama. Although blood tests were made each month, the Japanese laboratory technicians apparently lacked technical skill. Of 165 blood specimens checked by the United States Army, 127 were positive, 8 were unsatisfactory, 14 were doubtful and only 16 were actually negative, as compared to a low rate of positive reactions found by the Japanese. In Tokyo a similar check of smears for gonorrhea showed 85 percent of 219 positive instead of the 7 percent found positive by the Japanese.

CONTROL MEASURES

The whole venereal disease program has centered around the control of prostitutes. This was ineffective because the usual weekly examination was merely an inspection and only the most obvious infectious cases were detected and placed under treatment. There have been few mass blood-testing surveys for syphilis and very few public health activities concerning any of the venereal diseases.

The Honshu survey report cited the need for providing further educational material for the troops, for demonstrating proper techniques of modern methods of diagnosis and treatment to the Japanese, for "contact" reporting and apprehension of infected individuals, for maintaining well-supervised and efficient prophylactic stations, for studying chancroidal lesions, for furthering the good liaison established with civilian health authorities who appeared to be most cooperative and for making full use of "off-limits" action.

A system for the complete reporting of the three principal venereal diseases (syphilis, gonorrhea and chancroid) along with other reportable diseases, was established by the Public Health and Welfare Section of Headquarters, Supreme Commander for the Allied Powers on 16 October 1945. This directive also brought these three diseases under the provisions of the Law for the Prevention of Infectious Diseases. Action already had been initiated for prompt and complete reporting of all diseases coming under this law. Each Japanese physician was required to report infectious disease cases and deaths daily to a designated official in the local police or health department who, in turn, reports daily to the prefectural health department. The prefectural health department is required to report weekly to the Ministry of

Health and Social Affairs. Under this system the Ministry of Health had complete reports of communicable diseases tabulated within 13 days and transmitted them to the Public Health and Welfare Section, SCAP on the fourteenth day. In addition, any outbreaks of the more serious diseases such as typhus, cholera or plague were to be reported by telegraph. This reporting system was beginning to function during the survey and should be a valuable aid in controlling communicable diseases.

As a further venereal disease control measure, in mid-October the Tokyo Municipal Health Department promulgated a regulation extending the provisions of the laws concerning prostitutes by requiring that Geisha, waitresses, hotel maids and others who indulge in prostitution come under the basic law. These persons were required to hold a license card which would be withdrawn if the weekly physical examination revealed evidence of infection. Women found to be engaged in prostitution without the license card indicating weekly examinations were subject to arrest and detention.

It was stated that this Tokyo regulation would be adopted by all the prefectures. Its basic weakness was that many girls did not consider themselves prostitutes and remained unlicensed until discovered by the police. The physical examinations were completely inadequate until measures to make the examining methods acceptable were instituted by the Public Health Section of SCAP. Efforts were being made to uncover and treat all infectious cases. The Japanese government had a policy of nonfraternization, but several new brothels had been established to serve occupation troops.

As a part of the democratization of Japan a directive was issued by SCAP in January 1946 forbidding the sale of girls into prostitution and releasing those so bound. The effects of this action upon this business remain to be seen.

A new plan for more effective diagnosis of syphilis and gonorrhea has been developed by the Director of the Institute for Infectious Diseases. If approved by United States authorities, classes would be organized for the training of public health officers and medical technicians (Appendix E–1 and E–2). The Murata test was the standard test for syphilis, and had been tested against other recognized serodiagnostic tests by the League of Nations Commission at Copenhagen in 1924. The Ide test was also used. These tests were claimed to give results similar to the accepted United States tests. Laboratory facilities and supplies, however, were extremely limited for the satisfactory testing of many blood samples.

The plan proposed for diagnosing gonorrhea (Appendix E–2) provided for more adequate examinations and interpretations of smears. Cultures were to have been used when necessary. Technicians were to have been given special training in these methods. This proposed plan was also to have been recommended to all prefectures.

EFFECT OF BOMBING

Specific information regarding the effects of the air raids on the problem of venereal diseases was extremely difficult to elicit. In general, it was believed that the main effects were to aggravate the wartime conditions that had caused an increased incidence of these diseases. In many cities large segregated districts had been burnt out with the resultant dispersal of the prostitutes who were not casualties. For example, the Yoshiwara district in Tokyo, the largest segregated district in Japan, had been almost completely destroyed and there were only 50 girls left in the few remaining houses out of a former total of 3,000. The others were variously dispersed and their managers were looking for new quarters which were almost impossible to find.

Even under pre-raid conditions, venereal disease control was almost nil. Serious drug shortages, drugs of substandard strength and haphazard examination and treatment were pre-raid factors involved in the increasing venereal disease rates that were certainly not mitigated by the bombings.

It remains to be seen how effectively the combined efforts of the Japanese officials, the occupation forces and the United States Military Government can meet the many problems involved. Improved medical supplies and techniques, case-finding and treatment, education and repression of prostitution are all important factors in this program.

XI. MEDICAL SUPPLIES

The importance of medical supplies in the war potential of any nation should never be underestimated. Any noticeable reduction in these supplies, either locally or nationally, is detrimental to both the health and the morale of civilian populations. So it was in Japan where the production of medical supplies declined significantly because of war and bombing. This report, however, deals specifically and primarily with the actual condition of Japan's pharmaceutical industry before, during and after strategic attack of that country by the United States Air Forces.

JAPAN'S PREWAR SUPPLY OF PHARMACEUTICALS

According to the chief director of the Medicine Control Company, which controlled all domestic production, Japan did little manufacturing of medicines until after World War I, but imported most of them in the finished state from Germany. After World War I there was a tremendous growth of the pharmaceutical industry in Japan. Large stock piles were accumulated and manufacturing capacity grew almost large enough to supply the domestic demand. Production included the standard pharmaceutical supplies as well as a wide variety of proprietary preparations.

The Japanese people were heavy users of pharmaceuticals. In 1935 the total value of production was 140,000,000 Yen. Imports and exports almost balanced; the 5-year average of imports was 22,000,000 Yen and exports 24,000,000 Yen.

An indication of the extent of this industry was given in a report compiled by the Mitsubishi Economic Research Bureau in 1936. This report states,

> Good progress has been made in the production of pharmaceutical products of coal tar and alkaloid derivation, among which may be mentioned antipyrine, aspirin, saccharin, salicylic acid, quinine, codein phosphate and strychnine nitrate. The synthetic manufacture of adrenalin from safrol should also be mentioned, as well as recent advances in the manufacture of hydrogen peroxide, glycerine and formalin. Yeast for medicinal purposes was extensively produced by breweries. Although the output of medicinal products has expanded, it cannot yet compare with development of the industry in Europe and America.

TABLE 157.—*Leading Japanese manufacturers of pharmaceuticals and their products.*

Manufacturer	Products
Dai Ichi Seiyaku Kabushiki Kaisha, Nihonbashi Ku, Edobashi 3 Chome Tokyo. (Capital: yen 3,000,000.)	Abery (vitamin B compound), adalin, antimony preparations, arsphenamine, barbital, bismuth salts, chloramine, ethylene dichloride, lactic acid, mercurochrome, procaine hydrochloride, rivanol, spirocid, sulfonamides.
Dai Nippon Seiyaku Kabushiki Kaisha, Shitaya Ku, Yanaka, Tokyo, also Osaka. (Capital: yen 3,000,000.)	Chaulmoogra oil preparations, cotarnine, coramine, morphine, papaverine, tartar emetic, vitamins and other drugs.
Fujisawa Tomokichi Shoten Kabushiki Kaisha, Higashi Ku, Doshu Machi, Osaka (Capital: yen 3,150,000).	Camphor preparations, coramine macinin (santonin substitute) pituitary preparations, vitamin D preparations.
Government Hygienic Institute, Kanda Ku, Izumi Machi, Tokyo. Toku (Higashi Ku), Hyobashii Machi, Osaka.	Codein preparations, lobeline, morphine preparations, narcotine, opium, scopolamine, thebaine.
Hoshi Seiyaku Kabushiki Kaisha, Shinagawa Ku, Nishiosaki 1 Chome, Tokyo. (Capital: yen 16,650,000.)	Cocaine, diacetyl-morphine hydrochloride, morphine hydrochloride, quinine and quinine salts from their own plantations in Formosa.
Ishiji Seiyakusho, Tokyo	Ether, chloroform.
Radium Seiyaku Kabushiki Kaisha, Toshima Ku, Takata Minami Machi 3 Chome, Tokyo. (Capital: yen 1,000,000.)	Antimony compounds, cotarnine, hormones, narcopan (opium-morphine preparation), scopolamine hydro-chloride, vitamins.
Sankyo Kabushiki Kaisha, Nihonbashi Ku, Muromachi 2 Chome, Tokyo (also Osaka). (Capital: yen 15,000,000.)	Arsenicals (arsaminol, stovarsol and others), aspirin, calcium camphorate, cinchophen, cocaine and procaine, diacetylphenylisatin, digitalis, ephedrine, epirenamine chloride, hexamethylenetetramine, lactic acid, lienalin (spleen hormone), morphine, oryzanin, remijin (ethylhydrocuprein), tetrodotoxin, vitamins, yatren.
Shionogi Shoten Kabushiki Kaisha, Higashi Ku, Doshu Machi 3 Chome, Osaka.	Acriflavine, bismuth salts, boric acid, bromodiethylacetylurea, bromural, calcium cresol sulfonate, camphor preparations, cocaine, coramine, cotarnine, digitalis, ergot, hormones, lactic acid, menthol, navalgin, orthoform, pyridium, rivanol, tannin compounds, vaccines, vitamins and other drugs, chemicals and preparations.
Takeda Chobei Shoten, Higashi Ku, ooii Doshu Machi 2 Chome, Osaka. (Capital: yen 18,000,000.)	Acriflavine, arsinic acid, barbital, bromural, calcium preparations, camphor preparations, cocaine preparations, codein preparations, epirenamine chloride, ergot, hexamethylenetetramine, hormone preparations, insulin, lactic acid, mercurochrome, novalgin, phenol, quinine preparations, rivanol, vitamin preparations, yatren and other drugs and preparations.
Tababe Gobei Shoten, Higashiyodogawa Ku, Osaka. (Capital: yen 5,500,000.)	Antimony compounds, aspirin, diuretin and other diuretics, epirenamine chloride, hormone preparations, magnesium peroxide, navalgin pyridium, quinapon, vitamins, and others.
Tanabe Motosaburo Shoten Kabushiki Kaisha, Nihonbashi Ku, Hon Cho 2 Chome, Tokyo. (Capital: yen 1,000,000.)	Drugs, vitamins.

As a result of this development of the pharmaceutical industry Japan arrived at the eve of war with an adequate capacity for manufacturing many of the medical supplies required in the Home Islands. In two respects, however, the

source of supply was critically vulnerable. For certain drugs, Japan was forced to rely heavily upon imports of the finished product from Germany, the United States and other countries; domestic manufacture depended greatly upon the importation of the requisite crude drugs from other parts of the Empire and the mainland of Asia.

THE SUPPLY IN WARTIME

During the war years, 1941–45, the production of pharmaceuticals appears to have declined drastically. The extent of this decline is difficult to determine accurately. Several tables and graphs are presented below to indicate the over-all trend, both in the quota planned for production and the extent to which actual production met the plan.

Since the data from which these statistics have been obtained are at best fragmentary, and in some instances do not pertain to a uniform list of drugs, only very general conclusions can be reached. It is felt, however, that since all the information obtainable points in the same general direction, we may accept the conclusions as indicative of the over-all conditions in the pharmaceutical industry.

The difficulties under which individual physicians were forced to labor and their viewpoints as to what had caused the break-down of the medical supply system in general as well as the shortages of prescription drugs necessary for their particular medical practice, were learned by interviewing civilian physicians during the course of this investigation. While these individual interrogations did not always give a complete picture they were significantly indicative.

According to the chief of the Urological Clinic, Tokyo Imperial University, sulfa drugs and dyes for bacteriological staining (such as methylene blue) were difficult if not impossible to obtain. He further stated that in March 1945 the civilians actually suffered because of the lack of medical supplies. At the same time, evidence collected independently by the survey indicates that the Japanese military had hidden large stocks of these supplies throughout the country. This was apparently an attempt to maintain ready stocks for a last ditch stand in the Home Islands. The civilian population was deprived of even the commonest of drugs in this desperate stock-piling endeavor.

An interview with the Assistant Director of the Matsuzawa Psychopathic Hospital elicited information of a general character on the supply of medical services and pharmaceuticals available during the war. While he had no statistical information, he confirmed the impression that the medical profession experienced a shortage of medical supplies. According to him the situation assumed alarming proportions toward the end of 1943.

It was at this time that the government took cognizance of the impending critical shortage by setting up an advisory committee. This committee was for the purpose of standardizing the many types of preparations appearing on the market, since many of these were sufficiently similar to be utilized for common purposes. No headway was made along these lines and the shortage continued to grow more acute. The situation was aggravated when the civilian population flocked to the drugstores to purchase the few supplies available. Stocks were soon depleted.

An ill-conceived and wholly inadequate system of establishing stock piles of the important medical supplies for civilian use throughout Japan was instituted. With the onset of the air attacks even this pitiful expedient broke down and the situation became extremely serious.

Because of shortages of medical supplies, the Japanese government encouraged the use of herbs in the place of synthetic drugs. The government informed the people that they could revert to the medicines of their ancestors and be cured by them. In Osaka, 150 to 160 small stores were set up to collect and sell herbs. The quantity raised was not great, and the propaganda effect of the program upon the people was negligible.

Lt. Gen. Watanabe of the Medical Affairs Bureau, War Ministry, stated that the cultivation and harvest of the following medicinal herbs was emphasized in attempting to make Japan self-sufficient in drugs: Swerti japonica (Amara) Cassio Fora, morning glory (Cathartica), Geranium nepalense (Adstringentia), Platycodon grandiflorum (Expectorantia), Datura (Analgetica), Bupleurum falcatum, Pueraria hirsuta (Antifebrica), etc. It was apparent that the Japanese army tried to grow certain of

these herbs within their unit areas and again, to quote the Japanese report, "The result varied with units but was not successful—only less than 10 percent of quantity demanded was produced."

Table 158 gives the quota, actual production and the percent of the quota which was met by the actual production for 43 drugs decreed essential by the Japanese for military and civilian demands during the war years. Although the degree to which planned quotas were met by actual production varied greatly between drugs, the over-all trend indicated by this table is definitely downward.

Further details on quotas and production for a closely related group of drugs of special importance to both the military and civilians, namely sulfa drugs, are given in Table 159. In this particular group, production in 1943 exceeded the quota for the same year—for most items. In 1944, however, production had diminished to an average for all products in the group to about 27 percent. In 1945 a further decline brought the average production to less than four percent of the set quotas.

In the supply of surgical instruments the plight of the Japanese civilians appears to have been even worse than for pharmaceuticals. The investigations of the Survey have uncovered no evidence that surgical instruments were manufactured for civilian use from 1940 to 1945. A probable cause of this failure to provide such essential equipment is the greatly expanded requirements of the armed forces. Stainless steel instruments which have been in such general use in the United States do not appear to have been available at all to civilians in Japan. Plated instruments which rusted readily were the best available.

TABLE 158.[1]—*Annual quotas for Japan during 1942–45 of 43 essential drugs, amounts of these drugs produced and percentages of quotas represented by actual production.*

Item	Unit	Quota				Actual production				Percent of quota actually produced		
		1942	1943	1944	1945	1941	1942	1943	1944	1942	1943	1944
Albumin tannate	Kilogram	24,000	50,000	50,000	------	16,864	18,536	39,490	20,269	77	79	41
Aminopyrin	----do----	103,000	61,500	52,000	5,000	61,045	49,656	25,439	16,899	48	41	53
Antipyrin	----do----	108,000	65,000	4,000	------	90,524	103,560	24,864	7,454	96	38	186
Arsenobenzene and derivatives	----do----	7,640	5,083	7,184	1,690	3,000	7,518	6,540	3,678	98	129	51
Ascorbic acid	----do----	1,050	1,000	2,000	800	2,575	407	425	2,821	39	43	141
Atropine sulphate	----do----	100	50	35	------	7	0.8	0.3	16	8	0.6	46
Antipyrin-caffeine citrate	----do----	60,000	5,030	9,000	------	25,596	28,364	6,080	5,949	47	121	66
Aspirin	----do----	390,000	290,000	300,000	50,000	306,844	383,733	428,271	236,670	98	148	79
Bismuth subnitrate	----do----	40,000	30,000	60,000	20,000	77,381	73,583	43,222	29,700	184	144	50
Brom-diethyl-acetyl urea	----do----	1,000	1,000	808	------	1,027	775	1,156	518	78	116	64
Brom-isovaleryl urea	----do----	15,000	22,000	11,400	5,000	25,884	9,837	14,487	12,983	66	66	114
Caffeine with sodium benzoate	----do----	40,000	21,000	60,000	12,000	28,064	43,980	21,258	8,547	110	101	14
Cocaine hydrochloride	----do----	1,600	1,293	1,300	------	1,188	1,318	893	761	82	69	59
Codeine phosphate	----do----	3,700	4,000	4,000	660	4,000	4,200	2,200	2,000	114	55	50
Caffeine	----do----	45,000	49,784	50,000	23,000	45,526	36,295	41,853	22,965	81	84	46
Diethyl barbituric acid	----do----	11,000	12,000	8,000	2,725	9,029	5,623	3,452	1,214	51	29	15
Bismuth subgallate	----do----	20,000	15,000	15,000	4,500	18,082	4,741	12,566	9,252	24	84	62
Diastase	----do----	250,000	250,000	110,000	------	218,784	160,725	94,585	68,837	64	38	63
Diphtheria antitoxin	Liter	5,000	6,000	8,000	2,500	1,523	1,740	1,914	2,118	35	32	26
Ephedrin hydrochloride	Kilogram	3,200	3,440	2,843	1,100	2,565	3,941	3,869	1,477	123	112	52
Ether for anaesthetic	----do----	20,000	20,000	20,000	3,500	------	2,030	------	1,622	10	------	8
Ethyl-amino benzoate	----do----	10,100	4,100	3,768	1,500	6,990	5,909	3,040	2,667	59	74	71
Glucose	----do----	------	980,000	980,000	120,000	444,756	419,904	354,828	328,675	------	36	34
Guaiacol carbonate	----do----	21,000	22,000	14,300	------	19,828	8,405	9,434	7,660	40	43	54
Mercuric chloride	----do----	50,000	7,800	1,520	15,000	112,528	43,460	20,856	9,125	87	267	600
Mercurous chloride	----do----	8,000	5,000	------	------	8,934	5,412	2,901	1,878	68	58	------
Mercuric oxycyanide	----do----	1,000	1,920	270	------	1,361	765	425	289	77	22	107
Morphine hydrochloride	----do----	1,300	1,490	1,500	930	1,030	1,103	1,026	1,004	85	69	67
Milk sugar	----do----	------	400,000	500,000	300,000	276,200	247,175	310,125	444,054	------	78	89
Phenacetin	----do----	125,000	63,000	18,736	------	111,434	116,649	72,163	16,378	93	115	87
Potassium bromide	----do----	24,000	40,000	45,000	22,250	64,389	22,645	24,677	31,970	94	62	71
Procain hydrochloride	----do----	7,500	6,000	19,000	2,300	5,038	2,919	1,078	1,094	39	18	6
Potassium iodide	----do----	60,000	60,000	56,560	7,550	37,432	57,551	50,616	28,268	96	84	50
Quinine ethyl carbonate	----do----	20,000	20,500	4,000	------	6,143	3,553	4,050	3,324	18	20	83
Quinine sulphate	----do----	------	141,250	200,000	6,000	44,767	39,374	45,142	20,686	------	32	10
Saponated solution of cresol	----do----	1,620,000	2,000,000	1,290,000	132,000	1,515,258	964,612	1,126,658	851,230	60	56	66
Silver nitrate	----do----	20,000	10,000	30,000	1,200	26,863	17,065	9,829	2,912	85	98	10
Sodium bicarbonate	----do----	11,000,000	6,675,000	6,580,000	------	13,128,700	10,282,900	7,405,850	960,000	93	111	15
Sulfanilamide	----do----	180,000	100,000	100,000	10,000	270,724	259,674	120,568	26,956	144	121	27
Sulfapyridine	----do----	26,500	13,300	7,000	4,500	11,604	------	------	250	------	------	4
Tincture of iodine	----do----	170,000	173,000	120,000	36,000	93,085	99,044	135,331	53,232	58	78	44
Tropacocaine hydrochloride	----do----	80	100	100	50	19	51	4	50	64	4	50
Tetanus antitoxin:												
600 international units	Liter	------	164,800	7,600	2,075	1,622	1,285	2,070	1,173	------	1	15
1,000 international units	----do----	------	------	------	------	86	880	1,656	1,001	------	------	------

[1] Table reproduced as translated by the Japanese.
Source: Medicine Control Co., Ltd.

TABLE 159.—*Planned and actual production of sulfa drugs in Japan, 1943–45*

Item	1943			1944			1945		
	Planned (kilogram)	Actual (kilogram)	Ratio (percent)	Planned (kilogram)	Actual (kilogram)	Ratio (percent)	Planned (kilogram)	Actual (kilogram)	Ratio (percent)
Sulfanilamide	100,000	120,568	121	100,000	26,956	27	148,200	2,559	1.7
Disulfamine	22,000	46,079	209		8,603		40,900	853	211
Acetsulfamine	20,000	48,667	243	28,000	15,751	56	61,000	3,105	.9
Sulfaguanidine		[1] 4,008		18,000	15,769	88	33,500	2,633	5.7
Sulfapyridine	800	5,076	635	7,000	4,732	68	16,500	940	7.0
Sulfathiazol	9,000	5,136	57	142,000	6,595	5	22,500	1,357	5.4
Sulfamethylthiazol							23,600	87	6.0
Total	151,800	229,534	151	295,000	78,406	27	346,200	11,534	3.3

[1] Includes period from July to December only.
Source: Medicine Control Company, Ltd.

CAUSES OF THE DECLINE IN SUPPLY

The causes which operated in the decline in supply indicated in the previous section are too numerous and complex to allow complete analysis in this type of study. There are outstanding elements, however, which indicate the major causes of decline.

Loss of imports. As was stated at the beginning of this chapter, Japan had two major difficulties in maintaining an adequate domestic stock of medical supplies. Firstly, she relied upon importation of finished drugs from foreign countries in a more advanced stage of technological development. Secondly, the Home Islands were greatly dependent upon the remainder of the Empire and the mainland for imports of crude chemicals required in the manufacture of the finished drugs of which they were capable.

These two factors were largely responsible for the continuing reduction in medical supplies in the early part of the war.

Diversion of skilled labor. Another factor that added to difficulty in the domestic manufacture of medical supplies was the failure of the military to allocate skilled technicians to the drug manufacturing trades. No consideration was given by the Army and Navy to deferment of specialists in civilian occupations.

Civilian-military conflict. The distribution of drugs between civilian and military uses in Japan is evidence of a basic failure in war planning. In keeping with the general tendency to concentrate power in the hands of the military, the War Ministry was given control of the allocation of all pharmaceuticals during the war. The results of this formidable beginning bore out the direst of predictions.

To provide a comprehensive view of the allocation of drugs between the military and civilian sectors during the stage of planning for wartime drug production, 30 preparations have been studied by the Survey. The results of this study given in Table 160, show that the military were favored increasingly at the expense of the civilians despite a decline in the total planned availability. The fraction of the yearly production quota set aside for the Army and Navy rose steadily from 25 percent of the total in 1942 to 40 percent in 1945 with a corresponding decline in the percentages allocated for civilian use.

TABLE 160.—*Distribution of production quotas between civilian and military uses for thirty essential drugs, Japan, 1942–45*

Year	Kilograms			Percent		
	Military	Civilian	Total	Military	Civilian	Total
1942	723,978	2,150,092	2,874,070	25.2	74.8	100.0
1943	1,424,414	3,218,233	4,642,647	30.7	69.3	100.0
1944	1,357,006	2,585,969	3,942,975	34.4	65.6	100.0
1945	315,271	478,559	793,830	39.7	60.3	100.0

Source: Calculated from data of the Medicine Control Co., Ltd.

It will be noted from Tables 158 and 160 that production quotas for pharmaceuticals were set higher in 1943 and 1944 than in 1942. In 1945, however, they were reduced to approximately one-sixth of the 1943 level. In the special case of the sulfa drugs, Table 159 indicates that quotas for this group depended in large measure on the development of plants and methods used in their manufacture.

The diversion of medical supplies from the civilians to the military is even more forcibly brought out by reference to the allocation of actual production shown in Yen value in Table 161 for the same period of years.

TABLE 161.—*Distribution of actual production between civilian and military for selected medical supplies, Japan, 1941–45*

[In Yen value]

Year	Military (¥)	Civilian (¥)	Total (¥)	Military (percent)	Civilian (percent)	Total (percent)
1941	5,000,000	20,000,000	25,000,000	20.0	80.0	100.0
1942	6,000,000	16,000,000	22,000,000	27.3	72.7	100.0
1943	7,000,000	11,000,000	18,000,000	38.9	61.1	100.0
1944	7,000,000	7,000,000	14,000,000	50.0	50.0	100.0
1945	6,000,000	6,000,000	12,000,000	50.0	50.0	100.0

Source: Calculated from data of the Medicine Control Co., Ltd.

It is evident that while the percentage of medical supplies for military use actually increased two and one-half times from 1941 to 1945 there was a drastic reduction in the supplies available for civilian use, equivalent to approximately 70 percent of the 1941 Yen value. The results of the unequal struggle between the civilians and the military for medical supplies in Japan during the war years is shown graphically in Figure 75.

Bomb damage. The fourth factor was added in the latter part of 1944 and in 1945 with increasing effect when the air attack of the Home Islands took its toll of the pharmaceutical industry. In Table 162 are shown the number of manufacturers and their factories and the number and percentage of these factories damaged by bombs in each prefecture. While it is not considered that this list is a complete report for all pharmaceutical factories in Japan, it does indicate that of the 636 factories listed approximately 32 percent were damaged by bombs. It also indicates that the heaviest losses were sustained in those prefectures known to be the largest producers of pharmaceuticals.

It is apparent from Tables 157 and 162 that Tokyo prefecture was the most important area in Japan in the production of pharmaceuticals and the Osaka prefecture ranked second. Information was obtained by the Survey in the latter prefecture on the extent of damage to the more important factories in more detail than was available for the whole country. These data, shown in Table 163, indicate significantly that the structures in which the entire output of biologicals was centered in the prefecture were entirely destroyed.

TABLE 162.—*Bomb damage to pharmaceutical factories in Japan*

Prefecture	Manufacturers (number)	Factories (number)	Factories damaged by bombing	
			(Number)	(Percent)
Hokkaido	10	34	0	0
Aomori	0	1	0	0
Iwate	1	4	0	0
Miyagi	1	4	1	25
Akita				
Yamagato	0	1	0	0
Fukushima	1	5	1	20
Ibaragi	1	1	0	0
Tochigi	0	1	0	0
Gumma	2	5	0	0
Saitama	1	4	0	0
Chiba	5	19	2	10
Tokyo	156	203	111	54
Kanagawa	9	21	2	10
Niigata	1	2	0	0
Toyama	6	14	5	36
Ishikawa	1	2	0	0
Fukui	2	3	0	0
Yamanashi	0	3	2	67
Nagano	2	9	0	0
Gifu	2	5	0	0
Shizuoka	6	12	0	0
Aichi	11	22	7	32
Mie	8	10	0	0
Shiga	1	1	0	0
Kyoto	7	18	0	0
Osaka	98	150	51	34
Hyogo	14	32	9	28
Nara	1	1	0	0
Wakayama	2	8	1	12
Tottori	1	1	0	0
Shimane				
Okayama	2	3	0	0
Hiroshima	4	5	2	40
Yamaguchi	1	2	0	0
Tokushima	5	6	0	0
Kagawa	1	1	0	0
Ehime	1	1	0	0
Kochi				
Fukuoka	3	9	1	11
Saga	2	2	0	0
Nagasaki				
Kumamoto	7	8	5	62
Oita	1	2	0	0
Miyazaki				
Kagashima	1	1	0	0
Okinawa				
Total	378	636	200	32

Source: Ministry of Public Health and Welfare.

SUMMARY

After World War I there was a tremendous growth in the pharmaceutical industry in Japan. During this period and practically up to the beginning of World War II, Japan was dependent upon importations of certain finished drugs, in which there were technological difficulties in production, from the United States, Germany and other countries. At all times Japan was greatly dependent upon the importantion of crude chemicals for the manufacture of such drugs as her pharmaceutical houses could produce.

Japan's pharmaceutical industry contained many small establishments. The major concentration of the larger factories were to be found in approximately 11 of the 47 prefectures and of these 11 the Tokyo and Osaka prefectures

ALLOCATION OF SELECTED DRUGS TO MILITARY AND CIVILIAN USES.

JAPAN, 1941 - 1945

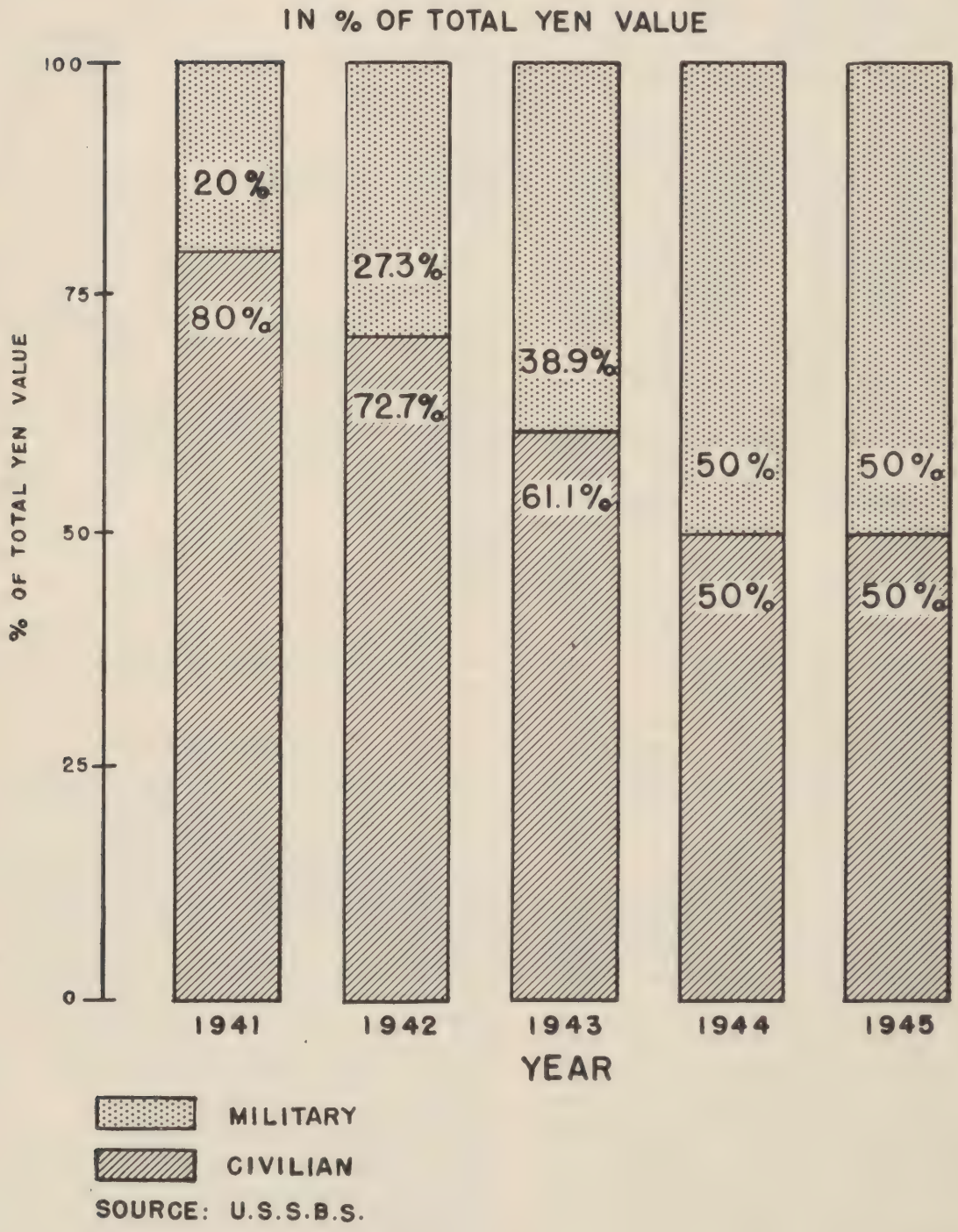


FIGURE 75

TABLE 163.—*Bomb damage to principal pharmaceutical factories in Osaka prefecture*

Factory	Principal products	Bomb damage (percent of structure)
Sumitomo Chemical Industrial Company, Torijima Factory.	Saccharine	80
	Phenacetin	50
Showa Chemical Industrial Company, Suita Factory.	Tartaric acid	70
	Citric acid	30
Dai Nippon Ether Industrial Company.	Ether	100
Tanabe Pharmaceutical Company, Honjo Factory.	Acetanilid	70
	Sulpha-guanadine	75
	Tannalbin, Dermatol, Soluble saccharine	50
Kashima Factory	*"Kiyonojin"*	50
	"Lysol"	60
	Sulpha pyridine	70
	Pure vitamin B_1	50
Dai Nippon Pharmaceutical Company, Factory No. 1.	Tartaric acid	20
	Rochelle salt	10
	"Cremol"	70
Kuroda Pharmaceutical Company, Gamo Factory.	Vitamin B_1	100
Shionogi Pharmaceutical Company, Kuize Factory.	"Tannalbin"	100
	Sodium salicylate	100
	"Shinomenim" hydrochloride	10
	"Digitamine"	10
Urae Factory	Ampule filling	80
Toyo Pharmaceutical and Synthetic Chemical Company, Oekijima Factory.	Galen's preparation	20
Takeda Pharmaceutical Company, Kanzakigawa Factory.	Boric acid, Borax, Medicated coal: (charcoal ?) (bonecoal ")	10
Sankyo Company, Osaka Factory.	Vitamin B_1	50
Osaka Bacterial Research Institute (Commercial).	Diphtheria serum, Various kinds of vaccines	100
Kumanoto Experimental Drug Research Institute (Commercial).	Diphtheria serum, Various serums	100

Source: Pharmaceutical Division, Osaka prefectural office.

probably contained more than 50 percent of the important factories.

All evidence points to a drastic decline in medical supplies including drugs beginning in 1941 and reaching its peak in 1945 when production was almost at a standstill. It is also evident that the decline in production developed gradually due to a sharp decline in imports of crude chemicals. In the last 2 months of 1944 and in 1945 bomb damage to pharmaceutical factories, especially those factories in the Tokyo and Osaka prefectures, accentuated this decline.

In comparing the break-down of the German and Japanese medical supply systems during the war, important differences were revealed. In Germany the break-down of the transportation system due to bombing was the primary cause of insufficient supply. In Japan the lack of materials, arising from blockade of imports of raw and finished drugs was the main factor. This basic weakness in the Japanese supply was aggravated by the lack of sufficient technical skill to create substitutes and the diversion of skilled technicians into the military service.

In the distribution of essential medical supplies to military and civilian populations there is little evidence that the military suffered any inconvenience. On the contrary, there is evidence that the military had on hand large stock piles which had been built at the expense of drastic restriction of the supplies produced for civilian usage. In fact, the curtailment of supplies for civilian use was so great that the Japanese government made a half-hearted attempt to persuade its people to use herbs and medicinal plants which could be grown locally.

The increasing lack of medical supplies made itself felt in many ways in the over-all health problems of the Japanese nation. This lack of supplies, superimposed upon a quality of medical service that was none too efficient, was definitely reflected in increasing case fatality rates and in the increase of disease generally.

Neither the practicing physician nor the general hospital could prescribe or supply the drugs ordinarily used in the course of routine treatment of disease. In special hospitals such as the mental hospitals and in the treatment of special diseases such as diabetes, patients either remained uncured or did not long survive when the specific drug necessary for the treatment of their cases was no longer available. The increased prevalence of diphtheria and the increase in the case fatality rate are indications of the lack of toxoid for immunization purposes and of serum in the treatment of the disease. As in Germany, tetanus was a frequent cause of death in burn cases, and in Japan tetanus antitoxin was practically unavailable when it was most needed.

In the treatment of bacillary dysentery, the supply of sulfaguanadine was so small that it was used only by the Army, despite the fact that bacillary dysentery and Ekiri were major causes of death in the civilian population, and even the Army use of sulfaguanidine was limited to certain areas of China. The other sulfa drugs, the use of which has grown so tremendously since the beginning of the war in most of the world, were almost completely unavailable for military or civilian use by 1945.

In 1945 when the production of medical supplies reached its lowest ebb, the requirement for these supplies reached its peak. With the increase of incendiary and demolition raids, hun-

dreds of thousands of casualties of all kinds were superimposed on mounting disease rates.

There is every reason to believe that had medical supplies been freely available and had they been used as would normally have been expected, thousands of lives would have been saved following urban area incendiary raids and especially after the atomic bombing of Hiroshima and Nagasaki.

APPENDIX A–1.—*Distribution and number of hospitals by prefectures, in Japan, 1945*

Prefecture	12 Oct.	19 Oct.	26 Oct.	2 Nov.
Hokkaido	267	267	267	265
Aomori	24	24	24	24
Iwate	41	41	41	41
Miyagi	43	43	43	46
Akita	28	28	28	28
Yamagata	22	22	22	22
Fukushima	51	51	51	51
Ibaraki	32	32	32	32
Tochigi	35	35	33	36
Gumma	54	54	54	54
Saitama	63	63	63	62
Chiba	99	99	------	99
Tokyo	164	164	203	203
Kanagawa	42	42	44	44
Niigata	57	57	58	59
Toyama	36	36	36	36
Ishikawa	50	50	50	------
Fukui	14	14	14	------
Yamanashi	15	15	15	15
Nagano	54	54	54	54
Gifu	33	33	33	33
Shizuoka	43	43	43	43
Aichi	75	75	75	75
Mie	45	45	45	45
Shiga	26	26	26	26
Kyoto	106	106	106	106
Osaka	126	126	139	139
Hyogo	82	82	82	82
Nara	20	20	20	------
Wakayama	15	15	15	15
Tottori	15	15	15	15
Shimane	20	20	20	20
Okayama	48	49	49	49
Hiroshima	43	43	43	------
Yamaguchi	------	------	------	------
Tokushima	15	15	15	15
Kagawa	27	27	27	27
Ehime	31	31	------	------
Kochi	21	21	21	21
Fukuoka	251	251	251	251
Saga	67	67	67	67
Nagasaki	44	------	------	------
Kumamoto	46	------	------	------
Oita	26	26	27	27
Miyazaki	19	19	------	23
Kagoshima	28	28	28	------

APPENDIX A–2.—*Weekly number of hospital patients by prefectures, 1945*

Prefectures	12 Oct.	19 Oct.	26 Oct.	2 Nov.	9 Nov.
Hokkaido	8,163	7,989	7,955	7,319	7,006
Aomori	811	831	857	1,387	1,441
Iwate	1,247	2,358	1,940	1,728	2,327
Miyagi	2,566	2,565	2,621	2,579	2,534
Akita	1,130	1,137	1,150	1,195	------
Yamagata	1,779	1,867	1,834	1,973	1,991
Fukushima	1,816	1,626	1,705	1,523	1,626
Ibaraki	484	487	552	591	------
Tochigi	1,256	1,280	658	625	622
Gumma	2,066	1,192	1,013	1,076	1,004
Saitama	2,066	864	1,483	1,398	1,399
Chiba	1,980	1,980	------	2,643	2,615
Tokyo	5,628	5,864	8,111	7,623	------
Kanagawa	1,973	2,149	1,891	1,821	1,702
Niigata	2,266	2,224	2,363	2,390	------
Toyama	1,389	1,389	1,342	1,217	------
Ishikawa	1,333	1,320	1,325	------	------
Fukui	620	681	633	------	------
Yamanashi	451	426	395	362	345
Nagano	2,066	1,332	1,493	1,527	1,522
Gifu	1,068	1,015	903	919	910
Shizuoka	1,344	1,281	1,148	1,203	------
Aichi	2,004	1,850	1,632	1,831	1,843
Mie	1,394	1,344	1,144	1,425	1,303
Shiga	886	855	831	782	768
Kyoto	3,318	3,441	3,120	2,576	2,762
Osaka	7,507	7,507	7,465	7,501	------
Hyogo	2,494	2,433	2,423	2,380	------
Nara	557	457	464	------	------
Wakayama	316	324	335	331	319
Tottori	946	922	881	820	761
Shimane	529	490	525	490	------
Okayama	1,461	1,197	1,163	1,164	------
Hiroshima	1,554	1,557	1,684	------	------
Yamaguchi	------	------	------	------	------
Tokushima	314	349	375	367	------
Kagawa	537	489	431	360	432
Ehime	731	718	------	------	------
Kochi	751	744	751	730	------
Fukuoka	4,682	4,617	4,659	4,573	4,416
Saga	896	898	887	901	913
Nagasaki	215	------	------	------	------
Kumamoto	590	------	------	------	------
Oita	490	524	501	477	461
Miyazaki	314	304	------	368	------
Kagoshima	325	347	351	------	------

APPENDIX A–3.—*Weekly numbers of hospital out-patients by perfectures, 1945*

Prefectures	12 Oct.	19 Oct.	26 Oct.	2 Nov.	9 Nov.
Hokkaido	31,001	30,586	30,223	30,795	29,973
Aomori	2,391	2,342	2,771	3,486	3,090
Iwate	6,401	6,615	5,718	4,053	4,017
Miyagi	5,738	4,401	4,848	5,805	5,982
Akita	5,449	5,261	5,528	4,831	------
Yamagata	2,763	5,419	248	2,910	2,575
Fukushima	7,157	6,710	6,468	5,698	6,019
Ibaraki	2,034	2,063	1,971	1,844	------
Tochigi	3,470	3,291	3,073	3,418	3,091
Gumma	6,225	16,857	2,994	3,067	2,740
Saitama	6,225	4,950	5,665	5,145	5,152
Chiba	5,940	5,940	------	6,433	6,962
Tokyo	11,418	11,093	16,408	------	------
Kanagawa	4,018	4,060	3,626	3,661	3,982
Niigata	7,250	7,128	7,257	7,034	------
Toyama	2,941	2,941	3,114	3,009	------
Ishikawa	3,550	3,681	4,075	------	------
Fukui	1,555	1,808	2,026	------	------
Yamanashi	1,231	1,163	1,262	1,306	1,071
Nagano	6,225	6,263	5,805	4,023	5,333
Gifu	4,050	3,779	3,632	3,958	3,726
Shizuoka	4,373	4,100	------	4,378	------
Aichi	7,551	7,701	6,780	7,104	7,726
Mie	4,492	4,155	4,673	4,586	4,376
Shiga	246	3,299	2,502	2,495	2,248
Kyoto	4,539	4,610	4,915	6,625	5,737
Osaka	11,429	11,849	13,049	------	------
Hyogo	8,014	7,858	7,801	7,943	------
Nara	1,592	2,567	1,969	------	------
Wakayama	1,396	1,466	1,416	1,369	1,280
Tottori	2,081	3,365	2,247	2,243	2,172
Shimane	1,514	1,536	1,493	1,623	------
Okayama	4,268	3,674	3,610	2,832	------
Hiroshima	2,110	------	4,211	------	------
Yamaguchi	------	------	------	------	------
Tokushima	1,150	1,152	1,124	1,325	------
Kagawa	2,204	2,249	1,986	2,228	1,884
Ehime	3,071	8,155	------	------	------
Kochi	1,776	1,792	1,802	1,831	------
Fukuoka	19,974	20,913	21,305	25,639	25,821
Saga	3,196	3,355	3,473	------	3,509
Nagasaki	2,282	------	------	------	------
Kumamoto	2,030	------	------	------	------
Oita	1,159	1,245	1,299	1,332	1,123
Miyazaki	1,712	1,621	------	1,714	------
Kagoshima	1,863	1,951	1,995	------	------

APPENDIX A–4.—*Numbers of proposed and established health centers by prectures in Japan, 1945*

Prefecture	Proposed numbers	Number already established	Number not yet established
Hokkaido	30	30	0
Aomori	9	9	0
Iwate	14	14	0
Miyagi	14	14	0
Akita	10	4	6
Yamagata	10	10	0
Fukushima	14	14	0
Ibaraki	15	10	5
Tochigi	11	11	0
Gumma	11	9	2
Saitama	13	8	5
Chiba	15	15	0
Tokyo	61	60	1
Kanagawa	13	12	1
Niigata	17	13	4
Toyama	10	6	4
Ishikawa	14	14	0
Fukui	15	15	0
Yamanashi	7	7	0
Nagano	15	15	0
Gifu	11	11	0
Shizuoka	16	12	4
Aichi	21	21	0
Mie	10	10	0
Shiga	10	10	0
Kyoto	12	12	0
Osaka	36	36	0
Hyogo	26	25	1
Nara	8	8	0
Wakayama	8	8	0
Tottori	5	5	0
Shimane	10	10	0
Okayama	15	15	0
Hiroshima	19	18	1
Yamaguchi	16	16	0
Tokushima	7	6	1
Kagawa	9	9	0
Ehime	15	15	0
Kochi	6	5	1
Fukuoka	29	29	0
Saga	5	5	0
Nagasaki	14	14	0
Kumamoto	12	12	0
Oita	14	14	0
Miyazaki	7	7	0
Kagoshima	13	13	0
Total	672	636	36

APPENDIX A–5.—*Maternal and child welfare, Japan*

Prefecture	Maternity hospitals	Circuit Midwives and nurses	Nurseries		Mothers and childrens home
			Permanent	Seasonal	
Hokkaido	11	1,065	22	412	1
Aomori		573	23	599	
Iwate	1	435	26	607	
Miyagi	7	733	30	603	1
Akita	1	330	18	1,082	
Yamagata		734	19	1,113	
Fukushima	1	952	25	693	
Ibaraki	5	613	18	685	1
Tochigi		365	14	837	
Gumma	1		26	485	
Saitama	5	771	11	1,002	
Chiba	10	800	41	635	
Tokyo	39	2,776	136	128	4
Kanagawa	7	1,112	50	175	3
Niigata	3		52	2,256	
Toyama	5	125	28	1,152	1
Ishikawa	5	380	48	382	
Fukui	3		26	882	
Yamanashi		208	7	325	
Nagano	3	773	45	416	2
Gifu	3	700	31	613	
Shizuoka	7	1,095	38	794	1
Aichi	16	985	98	1,997	3
Mie	3	973	25	749	1
Shiga		397	12	979	
Kyoto	16	922	76	571	1
Osaka	17	2,000	121	174	1
Hyogo	20	791	57	2,530	1
Nara			28	392	
Wakayama	2	320	20	352	
Tottori		190	19	391	1
Shimane	1	480	15	154	
Okayama	4	660	44	1,897	
Hiroshima	8	1,198	64	641	
Yamaguchi	3	595	57	1,596	2
Tokushima	2	255	31	296	
Kagawa	7	49	40	736	
Ehime	4	345	30	1,208	1
Kochi	10	265	30	168	
Fukuoka	35	1,026	54	1,774	2
Saga	10	550	35	636	1
Nagasaki	4	716	15	235	1
Kumamoto	4	1,524	36	1,145	
Oita	8	110	14	911	
Miyazaki	1	430	18	888	
Kagoshima	8	1,100	25	1,102	
Total	300	30,421	1,698	37,398	29
Years	(1941)	(1943)	(1941)	(1943)	(1941)

APPENDIX A–6.—*Medical schools of University rank in Japan, 1945*

Name	Dean of medicine or president	Location	Fixed number of annual admissions
Tokyo Imperial University	Akira, Takahashi	Motohuji-machi, Hongo-ku, Tokyo	130
Kyoto Imperial University	Shogo, Hunaoka	Yoshida-machi, Sakyo-ku, Kyoto city	150
Tohoku Imperial University	Yasutaro, Satake	Kita 4, Sendai city	120
Kyushu Imperial University	Shozo, Uuno	Katanuka-Kinpira, Fukuoka city	120
Hokkaido Imperial University	Sazaimon, Kudama	Kitahashijo, Sapporo city	120
Osaka Imperial University	Kozo, Tagagi	Tuneyasu-machi, Kita-ku, Osaka city	120
Nagoya Imperial University	Shinkichi, Tamura	Turamai-chiyo, Showa-ku, Nagoya city	120
Niigata Medical College	Takashi, Hashimoto	Asahimachi 1, Niigata city	100
Okayama Medical College	Taei, Shimizu	Oka, Okayama city	100
Chiba Medical College	Keiji, Koike	Yasaku-cho, Chiba city	100
Kanazawa Medical College	Shinkichi, Ishizaka	Tuchitoriba-Nagamachi, Kanazawa city	100
Nagasaki Medical College	Kokei, Hurayamo	Satokuni, Nagasaki city	100
Kumamoto Medical College	Itsuzo, Komiya	Honzyo-machi, Kumamoto city	100
Kyoto Furitsu Medical College	Noboru, Nakamura	Kamahara-machi, Kamikiyoku, Kyoto city	120
Keiogijiku University	Chutaro, Nishino	Shinano-machi, Yotsuya-ku, Tokyo	160
Nihon University	Fujio, Sakurazawa	Ouyaguchi, Itabashi-ku, Tokyo	100
Tokyo Jikeikai Medical College	Kikan, Takagi	Ataga-cho, Shiba-ku, Tokyo	160
Nihon Medical College	Hiroshige, Shiota	Komagomesendagi-cho Hongo-ku, Tokyo	160

APPENDIX A–7.—*Staff personnel of the Institute of Public Health, November 1945*

High official	Public health research and education department		Population problems department	Nutrition department	Industrial safety department
	Professor	Assistant professor			
First Grade	1				
Second Grade	1		1	1	
Third Grade	5	1	1	3	2
Fourth Grade	2	3	3		2
Fifth Grade		1	1	1	
Sixth Grade		3	3	1	1
Seventh Grade		2	1		
Eighth Grade					
Total	9	10	10	6	5

APPENDIX A–8.—*Comparative numbers of physicians and dentists by prefectures in Japan for 1938 and 1945; physician-and dentist-population ratios for 1945*

Prefecture	Physicians, 1938 (number)	Physicians, 1945 (number)	Physicians per 10,000 population, 1945	Dentists, 1938 (number)	Dentists, 1945 (number)	Dentists per 10,000 population, 1945
Hokkaido	1,946	1,285	3.43	714	749	1.99
Aomori	462	358	3.06	179	196	1.67
Iwate	554	488	3.68	134	163	1.23
Miyagi	1,388	707	4.53	259	225	1.44
Akita	481	508	4.07	171	209	1.67
Yamagata	545	453	3.41	167	198	1.49
Fukushima	728	859	4.23	310	393	1.93
Ibaraki	788	728	3.45	344	384	1.82
Tochigi	664	829	5.05	280	248	1.52
Gumma	687	566	3.43	287	292	1.78
Saitama	999	780	3.71	502	463	2.20
Chiba	1,302	933	4.43	469	446	2.12
Tokyo	12,987	2,926	8.93	5,343	1,632	4.98
Kanagawa	1,855	1,461	5.51	772	760	2.86
Niigata	1,317	1,459	5.66	404	483	1.87
Toyama	535	510	4.99	147	185	1.81
Ishikawa	954	481	5.07	184	177	1.86
Fukui	477	364	4.58	139	160	2.01
Yamanashi	367	408	4.75	140	184	2.14
Nagano	1,027	831	3.80	459	500	2.28
Gifu	783	834	5.06	317	319	1.93
Shizuoka	1,306	1,151	4.60	544	549	2.19
Aichi	2,569	1,845	5.61	1,031	905	2.75
Mie	912	569	3.77	339	299	1.99
Shiga	468	371	3.79	133	123	1.40
Kyoto	2,907	2,149	11.88	628	593	3.28
Osaka	4,790	2,128	6.88	1,816	1,209	3.91
Hyogo	3,103	1,503	4.51	1,075	630	1.89
Hara	357	374	4.14	166	166	1.84
Wakayama	580	482	4.62	218	206	1.97
Tottori	306	343	5.39	120	143	2.25
Shimane	591	405	4.66	190	183	2.11
Okayama	1,054	781	4.69	394	408	2.45
Hiroshima	1,442	1,277	5.78	550	556	2.52
Yamaguchi	986	705	4.73	343	334	2.24
Tokushima	506	318	3.60	128	146	1.65
Kagawa	485	326	3.69	193	184	2.08
Ehime	742	595	4.17	266	266	1.87
Kochi	462	382	4.81	143	142	1.79
Fukuoka	3,653	2,311	7.21	1,123	742	2.32
Saga	443	450	5.22	180	206	2.39
Nagasaki	942	748	4.78	361	293	1.87
Kumamoto	1,070	788	5.03	298	235	1.50
Oita	775	620	5.27	291	265	2.25
Miyazaki	393	299	3.18	135	150	1.59
Kagoshima	1,055	646	4.31	309	197	1.31
Total	62,743	39,334	5.04	22,695	17,496	2.24

APPENDIX A–9.—*Distribution of public health officials by prefectures in Japan, 1942*

Prefecture	Full-time health officers		Part-time health officer	Pharmacists		Veterinary surgeons		Dentists		Full-time sanitary engineers	Public health nurses
	A	B		A	B	A	B	A	B		
Hokkaido	16		3	2	3	1	14			9	248
Aomori	4	1		1	3	1	4			2	81
Iwate	6	2	2	1	3	1	6			1	50
Miyagi	14			2	3	1	11			5	62
Akita	4			1	2	1	6			1	39
Yamagata	7	1		1	3	1	5			2	170
Fukushima	8			1	2	1	8			4	55
Ibaraki	10			1	6	1	8	1		1	574
Tochigi	19			1	8	1	9			1	35
Gumma	9	2		2	3	1	12			2	63
Saitama	16		1	2	5	2	14				48
Chiba	18			2	5	2	19			3	67
Tokyo	76	46	5	7	31	6	45		1	58	1,174
Kanagawa	21	11	25	4	14	2	15			21	38
Niigata	18		20	3	6	1	14			4	33
Toyama	15	2		3	11	1	5			1	134
Ishikawa	16	6	6	7	9		4			1	67
Fukui	13	3	1	7	5		6			2	205
Yamanashi	6	2		7	6	1	7			1	15
Nagano	5	1		2	7	2	18			4	53
Gifu	21			1	5	1	7			6	75
Shizuoka	16	1		3	7	1	12			11	124
Aichi	25	5		4	9	1	32		1	27	147
Mie	14	5	15	1	6	1	6			3	49
Shiga	6	2	9	2	6	1	6			1	41
Kyoto	22	11		3	7	3	14			15	88
Osaka	53	7	7	7	22	3	36	1		78	479
Hyogo	34	2		3	15	2	33			20	110
Nara	10			3	6		11			1	19
Wakayama	12		2	2	7		6			2	33
Tottori	5	6		1	2		4			2	206
Shimane	9	3		1	3		12			2	134
Okayama	20	3	9	2	10	1	13			7	104
Hiroshima	22	4	12	3	9	2	19			12	84
Yamaguchi	24	1	1	1	8	1	16			5	106
Tokushima	6			3	4		5			1	41
Kagawa	10	1		1	3		8			2	96
Ehime	16	1		1	7		9			1	69
Kochi	7	4		1	4		8			1	12
Fukuoka	43	5		3	7	1	16			20	103
Saga	11	1		1	5	1	7			1	30
Nagasaki	12	8	3	2	5		14			8	64
Kumamoto	13		1	2	4	1	8			1	17
Oita	9	1		1	7	1	9			2	255
Miyazaki	5	6		1	3	1	15			1	65
Kagoshima	7	1		1	6	2	21	1		1	40
Total	733	155	122	111	312	51	577	3	2	354	5,802
Ministry of Health and Social Affairs	27	4	10	31	42	1		1		1	
General total	760	159	132	142	354	52	577	4	2	355	5,802

Note. A indicates high official.
B indicates junior official.

APPENDIX A–10.—*Distribution of public health officials by prefectures in Japan, 1944*

Prefecture	Full-time health officers		Part-time health officer	Pharmacists		Veterinary surgeons		Dentists		Full-time sanitary engineers	Public health nurses
	A	B		A	B	A	B	A	B		
Hokkaido	28			2	49	1	10			8	429
Aomori	11				15	1	4			3	240
Iwate	12			1	15	1	5			1	276
Miyagi	23			2	18	1	14			4	216
Akita	8			1	10	1	6			1	226
Yamagata	17			1	14	1	5			2	375
Fukushima	12			2	18	1	7			4	507
Ibaraki	11			1	17	1	8	1		2	195
Tochigi	22			1	22	1	4			1	248
Gumma	13			1	17	1	10			2	295
Saitama	15			2	18	2	12				210
Chiba	25			2	25	1	14			3	209
Tokyo	91			6	99	7	39	1	1	61	1,618
Kanagawa	22			3	21	2	15			25	254
Niigata	22			3	29	1	11			5	406
Toyama	15			2	17	1	4			1	314
Ishikawa	24			2	24		4			1	214
Fukui	14			1	19		6			2	165
Yamanashi	11			1	10	1	7			1	129
Nagano	14			1	22	2	14			4	252
Gifu	15			1	21	1	5			4	196
Shizuoka	23			2	22	1	10			9	401
Aichi	38			3	16	2	27	1		25	420
Mie	17			1	21	1	6			4	222
Shiga	12			1	15	1	6			1	197
Kyoto	27			1	16	3	14			12	217
Osaka	44			3	39	3	36	1		65	514
Hyogo	30			4	30	2	33			23	429
Nara	11			3	9		8			1	131
Wakayama	13			1	18		6			3	104
Tottori	7			1	9		4			2	196
Shimane	12			1	16		3			2	279
Okayama	20			2	25	1	13			6	286
Hiroshima	35			2	29	3	17			17	368
Yamaguchi	25			1	16	1	13	1		6	237
Tokushima	10			3	9		5			1	165
Kagawa	17			1	13		8			2	164
Ehime	15			1	21		8			3	276
Kochi	8			1	11	1	9		1	1	114
Fukuoka	70			4	41	1	15			24	340
Saga	11			1	13	1	6			1	126
Nagasaki	20			1	20	1	11			8	181
Kumamoto	15			3	17	1	10			1	280
Oita	11			2	17	1	3			2	168
Miyazaki	10			1	9	1	6			1	114
Kagoshima	14			1	17	2	21	1		1	184
Total	940			81	969	55	502	6	2	356	13,087
Ministry of Health and Social Affairs	31			36	44	1		2	2	1	
General total	971			117	1,013	56	502	8	4	357	13,087

Note. A indicates high official.
B indicates junior official.

APPENDIX A–11.—*Public health officials in Japan, number and distribution according to population*

Type	Number		Distribution per 1,000,000	
	1942	1944	1942	1944
Full-time health officers:				
High official	760	971	10.17	13.37
Junior official	159		2.11	
Part-time health officers	132		1.75	
Public health nurses	5,802	13,087	77.28	181.54
Veterinary surgeons:				
High official	52	56	0.69	0.76
Junior official	557	502	7.89	7.05
Pharmacist:				
High official	142	117	1.66	1.60
Junior official	354	1,013	4.73	13.89
Dentists:				
High official	4	8	0.05	0.11
Junior official	2	4	0.02	0.06
Full-time sanitary engineers	355	357	4.91	4.96

APPENDIX A–12.—*Numbers of nurses, veterinarians, pharmacists and midwives by prefectures in Japan, 1938 and 1945*

Prefecture	Nurses		Veterinarians		Pharmacists		Midwives
	1938	1945	1938	1945	1938	1945	1938
Hokkaido	2,290	4,134	1,375	1,018	734	891	2,352
Aomori	652	712	546	140	96	113	922
Iwate	1,418	1,276	690	127	108	54	837
Miyagi	3,325	1,300	546	1,863	208	170	1,443
Akita	782	1,127	353	145	101	110	754
Yamagata	1,148	1,306	256	72	119	136	1,099
Fukushima	1,536	2,956	504	126	207	255	1,277
Ibaraki	1,139	1,481	361	130	217	375	1,017
Tochigi	1,889	2,971	261	217	214	310	630
Gumma	2,263	1,389	204	90	259	310	843
Saitama	1,744	764	241	45	327	645	956
Chiba	1,277	2,808	460	120	479	420	1,151
Tokyo	23,045	3,600	1,561	335	7,576	5,000	7,745
Kanagawa	7,381	1,194	200	30	1,081	1,550	1,847
Niigata	2,797	2,498	309	110	276	352	2,059
Toyama	819	2,200	103	50	396	606	473
Ishikawa	1,350	1,286	286	76	281	255	526
Fukui	854	1,950	95	25	159	148	403
Yamanashi	600	752	108	45	131	156	295
Nagano	1,266	1,795	328	151	318	419	1,165
Gifu	1,443	1,386	214	86	403	553	918
Shizuoka	2,901	3,576	232	56	540	606	1,532
Aichi	4,483	6,209	227	201	1,668	1,650	2,758
Mie	1,354	1,240	159	30	399	500	1,270
Shiga	752	1,039	80	38	246	186	616
Kyoto	4,906	4,099	140	126	1,234	1,319	1,575
Osaka	9,565	6,061	408	163	4,028	4,525	4,935
Hyogo	8,566	8,961	367	263	1,678	1,629	2,979
Nara	860	452	56	35	265	236	694
Wakayama	1,214	932	73	26	330	223	1,042
Tottori	996	1,552	151	70	110	120	402
Shimane	1,182	1,150	257	73	128	150	609
Okayama	1,971	2,301	483	119	307	299	863
Hiroshima	3,952	4,100	502	2	551	990	1,500
Yamaguchi	1,921	2,294	521	173	334	177	735
Tokuchima	656	675	137	48	173	199	546
Kagawa	1,239	985	97	33	195	196	511
Ehime	1,434	270	176	57	192	267	857
Kochi	605	420	138	52	145	145	498
Fukuoka	5,649	4,523	470	156	1,069	799	3,070
Saga	900	1,830	192	40	162	210	797
Nagasaki	1,483	964	175	97	413	323	1,197
Kumamoto	1,979	850	855	187	392	320	1,584
Oita	992	1,893	658	148	250	285	720
Miyazaki	317	752	660	93	112	88	659
Kagoshima	1,068	2,231	913	323	177	94	1,332
Total	119,963	98,244	17,128	7,610	28,788	28,364	61,993

APPENDIX B–1.—*Nutrients available for civilian consumption, Japan, 1941*

Item	Calories (number)	Protein (grams)	Fat (grams)	Calcium (milligrams)	Carbohydrate (grams)	Vitamin A (international units)	Thiamine (milligrams)	Riboflavin (milligrams)	Niacin (milligrams)	Ascorbic acid (milligrams)
Rice	1,146	27.0	3.4	67.4	256.1		0.58	0.12	6.7	
Wheat	128	3.2	.3	1.8	27.4		.10	.02	.3	
Barley	56	1.4	.3	8.0	11.7		.04	.01	.5	
Naked barley	81	2.5	.4	11.5	16.1		.06	.02	.7	
Soybeans	28	2.9	1.4	16.0	1.0		.03	.03	.2	
Other grains	29	.8	.3	2.4	5.8	5	.03	.01	.1	
Beans	22	1.4	.1	3.5	3.9		.02	.01	.2	
Sweet potatoes	73	1.1	.4	18.3	16.1	5,621	.07	.04	.5	12
Potatoes	38	.9	.1	5.4	8.6	11	.05	.02	.7	8
Vegetables	66	2.4	.4	78.8	13.1	2,315	.18	.15	.7	50
Fruits	21	.2	.1	8.5	5.2	289	.02	.01	.1	9
Fish	71	12.5	2.6	14.3		238	.02	.24	6.0	
Seaweed	12	.6		22.0	2.0	3	.01	.01	.1	2
Oils and fats	36		4.0							
Sugar	124				31.0					
Meat	13	.9	1.0	.5			.02	.01	.4	
Eggs	6	.5	.4	2.0		46	.01	.02		
Milk, condensed and powdered	2	.1	.1	1.5	.1	3				
Butter	1		.1			3				
Miso	35	2.6	.9	23.1	3.8		.04		.2	
Shoyu	19	2.5		6.2	1.6			.01	.3	
Total	2,007	63.5	16.3	291.2	403.5	8,534	1.28	0.73	17.7	81

APPENDIX B–2.—*Nutrients available for civilian consumption, Japan, 1942*

Item	Calories (number)	Protein (grams)	Fat (grams)	Calcium (milligrams)	Carbohydrate (grams)	Vitamin A (international units)	Thiamine (milligrams)	Riboflavin (milligrams)	Niacin (milligrams)	Ascorbic acid (milligrams)
Rice	1,204	28.3	3.5	70.8	269.0		0.61	0.12	7.1	
Wheat	135	3.4	.3	1.9	28.9		.11	.02	.3	
Barley	60	1.5	.3	8.5	12.4		.05	.01	.5	
Naked barley	77	2.4	.4	11.0	15.4		.06	.02	.7	
Soybeans	36	3.6	1.8	20.0	1.2		.04	.03	.2	
Other grains	22	.6	.2	1.8	4.4	4	.02	.01	.1	
Beans	19	1.2	.1	3.0	3.4		.02	.01	.1	
Sweet potatoes	67	1.0	.4	16.8	14.7	5,159	.07	.04	.5	11
Potatoes	39	1.0	.1	.6	9.0	11	.05	.02	.7	8
Vegetables	65	2.4	.4	77.4	12.9	2,273	.17	.15	.7	50
Fruits	23	.3	.1	9.0	5.5	308	.03	.02	.2	10
Fish	63	11.0	2.3	12.6		210	.02	.21	5.3	
Seaweed	16	.8		27.5	2.5	4	.02	.02	.1	3
Oils and fats	27		3.0							
Sugar	124				31.0					
Meat	13	.9	1.0	.5			.02	.01	.4	
Eggs	6	.5	.4	2.0		46	.01	.02		
Milk, condensed and powdered	2		.1	1.3	.1	2				
Butter	1		.1	.1		3				
Miso	28	2.1	.8	18.7	3.1		.03		.1	
Shoyu	14	2.0		4.8	1.3			.01	.2	
Total	2,041	63.0	15.3	288.3	414.8	8,020	1.33	.72	17.2	82

APPENDIX B–3.—*Nutrients available for civilian consumption, Japan, 1943*

Item	Calories (number)	Protein (grams)	Fat (grams)	Calcium (milligrams)	Carbohydrate (grams)	Vitamin A (international units)	Thiamine (milligrams)	Riboflavin (milligrams)	Niacin (milligrams)	Ascorbic acid (milligrams)
Rice	1,224	28.8	3.6	72.0	273.6		0.62	0.13	7.2	
Wheat	107	2.7	.3	1.5	22.8		.08	.02	.2	
Barley	49	1.3	.2	7.0	10.2		.04	.01	.4	
Naked barley	63	2.0	.3	9.0	12.6		.05	.01	.5	
Soybeans	36	3.6	1.8	20.0	1.2		.04	.03	.2	
Other grains	22	.6	.2	1.8	4.4	4	.02	.01	.1	
Beans	19	1.2	.1	3.0	3.4		.02	.01	.1	
Sweet potatoes	101	1.5	.6	25.3	22.2	7,777	.10	.06	.7	17
Potatoes	41	1.0	.1	.6	9.4	12	.05	.02	.7	9
Vegetables	68	2.5	.5	82.1	13.7	2,410	.18	.16	.7	52
Fruits	22	.2	.1	8.8	5.4	301	.03	.02	.2	10
Fish	61	10.6	2.2	12.1		202	.02	.20	5.1	
Seaweed	16	.8		27.5	2.5	4	.02	.02	.1	3
Oils and fats	27		3.0							
Sugar	96				24.0					
Meat	11	.7	.9	.4			.02		.4	
Eggs	4	.3	.3	1.5		34		.01		
Milk, condensed and powdered	1			1.0		2				
Butter	1		.1			3				
Miso	30	2.3	.8	19.8	3.2		.03		.1	
Shoyu	14	1.8		4.5	1.2			.01	.2	
Total	2,013	61.9	15.1	297.9	409.8	10,749	1.32	.72	16.9	91

APPENDIX B–4.—*Nutrients available for civilian consumption, Japan, 1944*

Item	Calories (number)	Protein (grams)	Fat (grams)	Calcium (milligrams)	Carbohydrate (grams)	Vitamin A (international units)	Thiamine (milligrams)	Riboflavin (milligrams)	Niacin (milligrams)	Ascorbic acid (milligrams)
Rice	1,122	26.4	3.3	66.0	250.8		0.57	0.12	6.6	
Wheat	135	3.4	.3	1.9	28.9		.11	.02	.3	
Barley	67	1.7	.3	9.5	13.9		.05	.02	.6	
Naked barley	77	2.4	.4	11.0	15.4		.06	.02	.7	
Soybeans	39	4.0	2.0	22.0	1.3		.05	.04	.2	
Other grains	22	.6	.2	1.8	4.4	4	.02	.01	.1	
Beans	19	1.2	.1	3.0	3.4		.02	.01	.1	
Sweet potatoes	108	1.6	.6	27.0	23.8	8,316	.11	.07	.8	18
Potatoes	36	.9	.1	.5	8.3	10	.05	.02	.6	8
Vegetables	64	2.3	.4	76.3	12.7	2,241	.17	.15	.6	49
Fruits	15	.2	.1	5.9	3.6	203	.02	.01	.1	7
Fish	51	8.9	1.9	10.2		170	.02	.17	4.3	
Seaweed	16	.8		27.5	2.5	4	.02	.02	.1	3
Oils and fats	9		1.0							
Sugar	56				14.0					
Meat	11	.7	.9	.4			.02	.01	.4	
Eggs	4	.3	.3	1.5		34		.01		
Milk, condensed and powdered	1			.5		1				
Butter	1		.1			3				
Miso	31	2.4	.9	20.9	3.4		.03		.1	
Shoyu	12	1.6		4.1	1.1			.01	.2	
Total	1,896	59.4	12.9	290.0	387.5	10,986	1.32	.71	15.8	85

APPENDIX B–5.—*Nutrients available for civilian consumption, Japan, 1945*

Item	Calories (number)	Protein (grams)	Fat (grams)	Calcium (milligrams)	Carbohydrate (grams)	Vitamin A (international units)	Thiamine (milligrams)	Riboflavin (milligrams)	Niacin (milligrams)	Ascorbic acid (milligrams)
Rice	1,047	24.6	3.1	61.6	234.4	----	0.53	0.11	6.2	----
Wheat	89	2.3	.2	1.3	19.0	----	.07	.01	.2	----
Barley	42	1.1	.2	6.0	8.8	----	.03	.01	.4	----
Naked barley	56	1.8	.3	8.0	11.2	----	.04	.01	.5	----
Soybeans	46	4.7	2.3	26.0	1.6	----	.06	.04	.3	----
Other grains	18	.5	.2	1.5	3.7	3	.02	.01	.1	----
Beans	19	1.2	.1	3.0	3.4	----	.02	.01	.1	----
Sweet potatoes	115	1.7	.7	28.8	25.3	8,855	.12	.07	.8	20
Potatoes	48	1.2	.1	.7	10.9	14	.06	.03	.8	10
Vegetables	58	2.1	.4	69.8	11.6	2,051	.16	.14	.6	45
Fruits	14	.2	.1	5.4	3.3	185	.02	.01	.1	6
Fish	42	7.4	1.5	8.4	----	140	.01	.14	3.5	----
Seaweed	16	.8	----	27.5	2.5	4	.02	.02	.1	3
Oils and fats	9	----	1.0	----	----	----	----	----	----	----
Sugar	8	----	----	----	2.0	----	----	----	----	----
Meat	9	.6	.7	.4	----	----	.02	.01	.3	----
Eggs	6	.5	.4	2.0	----	46	.01	.02	----	----
Milk, condensed and powdered	1	----	----	.5	----	3	----	----	----	----
Butter	1	----	.1	----	----	3	----	----	----	----
Miso	28	2.1	.8	18.7	3.1	----	.03	----	.1	----
Shoyu	9	1.3	----	3.2	.8	----	----	----	.2	----
Total	1,681	54.1	12.2	272.8	341.3	11,304	1.22	.64	14.3	84

APPENDIX B–6.—*Japenese Imperial Government Institute for Nutrition Research, daily calorie and protein requirements*

Age	Work [1]	Male		Female	
		Calories (kilogram)	Protein	Calories (kilogram)	Protein
Less than 1	----	90–130	----	90–130	----
1	----	850	35	850	35
2	----	1,200	50	1,200	50
3	----	1,320	55	1,320	55
4	----	1,430	60	1,430	60
5	----	1,490	60	1,490	60
6	----	1,610	65	1,500	60
7	----	1,690	70	1,570	65
8	----	1,740	70	1,630	70
9	----	1,800	75	1,680	70
10	----	1,880	80	1,740	70
11	----	1,930	80	1,830	75
12	----	2,050	85	1,930	80
13	Light	1,900	85	1,750	80
	Moderate	2,160	90	2,030	85
	Comparatively heavy	2,400	95	2,250	90
	Heavy	2,700	100	----	----
14	Light	2,000	90	1,800	95
	Moderate	2,260	95	2,100	90
	Comparatively heavy	2,500	100	2,330	95
	Heavy	2,800	105	----	----
15	Light	2,100	95	1,820	85
	Moderate	2,360	100	2,120	90
	Comparatively heavy	2,650	105	2,350	95
	Heavy	2,900	110	----	100
16	Light	2,150	95	1,800	85
	Moderate	2,630	100	2,100	90
	Comparatively heavy	2,700	105	2,330	95
	Heavy	3,000	110	2,580	100
	Very heavy	3,350	120	----	----
17–20	Light	2,200	95	1,800	85
	Moderate	2,500	100	2,100	90
	Comparatively heavy	2,800	105	2,330	95
	Heavy	3,100	115	2,580	100
	Very heavy	3,450	120	----	----
21–30	Light	2,200	80	1,700	65
	Moderate	2,500	85	2,000	70
	Comparatively heavy	2,800	90	2,200	75
	Heavy	3,100	95	2,400	80
	Very heavy	3,450	105	----	----
31–50	Light	2,100	75	1,600	60
	Moderate	2,400	80	1,900	65
	Comparatively heavy	2,700	85	2,100	70
	Heavy	3,030	90	2,300	85
	Very heavy	3,300	100	----	----
51–60	Light	2,000	55	1,550	45
	Moderate	2,250	60	1,800	50
	Comparatively heavy	2,500	65	2,000	55
	Heavy	2,800	70	2,150	60
	Very heavy	----	----	----	----
Above 61	Light	1,800	50	1,450	40
	Moderate	2,100	55	1,700	45
	Comparatively heavy	2,350	60	1,850	50
Average moderate	----	2,351	85	----	----
Average total	----	2,290	83	----	----

[1] Some occupations classified from viewpoint of activity:
- *a. Light work*—Clerk, secretary, shopman, mental worker, government official, priest, shinto-priest, writer, etc.
- *b. Moderate work*—Sewer, farmer (in leisure season), artisan, teacher of primary school, physician, etc.
- *c. Comparatively heavy work*—Peddler, turner, compositor, shoemaker, bookbinder, laboratory worker, mailman, nurse, etc.
- *d. Heavy work*—Carpenter, plasterer, metal worker, farmer (in farming season), etc.
- *e. Very heavy work*—Stone mason, wood cutter, sawyer, fisherman, etc

APPENDIX B–7.—*Japanese Public Health Committee on Efficiency of Nutrition—wartime standards for daily calarie and protein requirements*

Age	Male		Female	
	Calories	Protein	Calories	Protein
1	900	35	850	35
2	1,100	40	1,050	38
3	1,175	43	1,120	41
4	1,250	45	1,190	43
5	1,325	48	1,260	46
6	1,400	51	1,330	49
7	1,475	53	1,400	52
8	1,550	56	1,470	54
9	1,625	59	1,540	57
10	1,700	61	1,610	59
11	1,775	64	1,680	62
12	1,850	67	1,750	65
13	1,925	70	1,825	68
14	2,000	72	1,900	70
15	2,250	75	1,900	70
16	2,500	77	1,900	70
17	2,100	80	1,900	70
18	2,100	80	1,900	70
19	2,100	80	1,900	70
20–29	2,100	75	1,800	65
30–49:				
Average	2,000	70	1,700	60
Light work [1]	1,900	70	1,600	60
Moderate [2]	2,400	70	2,000	60
Heavy [3]	2,800	70	2,400	60
Very heavy [4]	3,200	70		
50–59	1,900	60	1,600	50
60 and over	1,750	50	1,500	40

[1] *Light work*—lens examiners, reporters, assemblers of communication equipment and machine tools, gas welders, makers of electric bulbs and vacuum tubes, office workers, professional workers.
[2] *Moderate work*—lens workers, metal press workers, machine tool and parts makers, metal cutters, nurses, drivers, domestic workers.
[3] *Heavy work*—metal foundry men, packers, riveters, woodworkers, delivery men.
[4] *Very heavy work*—steel refinery workers, farmers, firemen, stone masons, fishermen, warehousemen, stevedores and blacksmiths.
Source: Institute of Hygiene, Kyoto Imperial University, Japan.

APPENDIX B–8.—*Daily calorie and protein requirements of pregnant and nursing women—Japanese Imperial Government Institute for Nutrition Research*

Age	Work classification	Pregnant women				Nursing women					
		Month of pregnancy				Time post-parturition					
		1–5 months		6–10 months		3 weeks		1–6 months		7–12 months	
		Calories	Protein (grams)	Calories	Protein (grams)	Calories	Protein (grams)	Calories	Protein (grams)	Calories	Protein (grams)
21–30	Light	2,050	80	2,200	85	1,900	70	2,050	80	2,200	85
	Moderate	2,400	85	2,600	90	2,200	75	2,400	85	2,600	90
	Comparatively heavy	2,650	90	2,850	100			2,650	90	2,850	100
31–50	Light	1,900	70	2,100	80	1,750	65	1,900	70	2,100	80
	Moderate	2,300	80	2,500	85	2,100	70	2,300	80	2,500	85
	Comparatively heavy	2,550	85	2,750	90			2,550	85	2,750	90

APPENDIX B–9.—*Basal metabolism of Japanese*

[Calories per person per day]

Age	Male	Female
2	707.90	642.53
3	769.82	716.14
4	833.75	767.47
5	863.28	812.76
6	906.34	843.36
7	950.98	883.73
8	979.07	917.09
9	1,014.60	944.06
10	1,055.23	980.40
11	1,084.46	1,030.61
12	1,153.68	1,085.58
13	1,213.80	1,143.38
14	1,269.84	1,182.14

[Calories per person per day]

Age	Male	Female
15	1,325.52	1,190.25
16	1,367.52	1,182.72
17	1,395.24	1,175.76
18	1,403.58	1,166.88
19	1,411.92	1,158.30
20	1,413.12	1,148.49
21–30	1,392.23	1,126.68
31–50	1,343.22	1,061.51
51–60	1,264.64	1,004.36
61 and over	1,200.28	967.90

Source: K. Sugimoto, Imperial Government Institute for Nutrition Research, 4 Dec. 1944, Tokyo, Japan.

APPENDIX C-1.—*Air-raid casualties reported by the Japanese Ministry of Home Affairs for 163 bombed cities and related information*

Prefecture and city	Population 1944	Casualties			Casualties per 1,000 population				Percent of built-up area destroyed
		Deaths	Injuries	Total	Deaths	Injuries	Total	Bomb tonnage	
Hokkaido:									
Hakodate	152,148	19	22	41	0.1	0.1	0.2	77	
Muroran	124,049	408	164	572	3.3	1.3	4.6	83	
Kushiro	58,962	184	167	351	3.1	2.8	5.9	37	
Asahikawa	225,981	1	16	17		.1	.1		
Otarn	152,148	10	17	27	.1	.1	.2	2	
Obihiro	38,066	2	4	6	.1	.1	.2	19	
Aomori:									
Aomori	100,093	1,018	255	1,273	10.2	2.5	12.7	771	29.0
Machinobe	77,914	22	21	43	.3	.3	.6	88	
Iwate:									
Morioka	90,494	6	19	25	.1	.2	.3	22	
Kamaishi	41,255	564	553	1,117	13.7	13.4	27.1	15	
Miyakoshi	34,731	9	6	15	.2	.2	.4		
Miyagi:									
Sendai	264,277	992	1,687	2,679	3.7	6.4	10.1	1,047	27.0
Ishimaki	35,087	13	16	29	.4	.4	.8		
Shiogama	32,128	3	3	6	.1	.1	.2		
Akita:									
Akita	97,875	105	93	198	1.1	.9	2.0	1,033	
Yamagata:									
Sakada	39,190	18	33	51	.5	.8	1.3		
Fukushima:									
Taira	28,756	22	99	121	.8	3.4	4.2	43	
Koriyama	58,284	388	354	742	6.6	6.1	12.7	612	
Ibanaki:									
Mito	66,082	205	662	867	3.1	10.0	13.1	1,197	65.0
Sitachi	84,600	1,019	424	1,443	12.0	5.0	17.0	976	78.2
Tsuchiara	45,160	4	15	19	.1	.3	.4	3	
Tochigi:									
Tochigi	30,854	2		2	.1		.1		
Ashikoga	47,715	6	3	9	.1	.1	.2		
Utsunomiya	90,788	570	1,189	1,759	6.3	13.1	19.4	847	32.0
Gumma:									
Mebashi	85,386	471	168	639	5.5	2.0	7.5	725	40.0
Tekasaki	71,043	18	33	51	.3	.4	.7	30	
Isezaki	40,450	9		9	.2		.2	614	
Miriu	77,205	1		1				18	
Saitoma:									
Grawa	80,181	18	35	53	.2	.4	.6		
Kawaguchi	89,450	29	101	130	.3	1.0	1.3		
Omiya	79,771	12	15	27	.2	.2	.4	11	
Kumagae	52,226	242	614	856	4.6	11.8	16.4	606	
Kawagoe	38,873	5	6	11	.1	.2	.3		
Chiba:									
Chiba	110,095	861	776	1,637	7.7	7.0	14.7	1,040	43.4
Ichikawa	69,711	8	36	44	.1	.5	.6		
Funahaski	60,762	2	24	26		.4	.4		
Matsudo	37,011	15	14	29	.4	.4	.8	11	
Choshi	62,000	394	248	642	6.3	3.9	10.2	704	43.0
Kisarazu	35,236	7	14	21	.2	.4	.6	37	
Tateyama	31,340	33	62	95	1.0	2.0	3.0	77	
Tokyo:									
Tokyo	6,577,620	93,056	59,633	152,698	14.1	9.1	23.2	16,568	50.8
Hachioji	77,694	290	70	360	3.7	.9	4.6	1,594	80.0
Tachikawa	55,144	435	278	713	7.9	5.0	12.9	1,295	
Kanagawa:									
Yokohama	1,034,740	4,616	14,215	18,831	4.5	13.7	18.2	2,605	44.0
Kawasaki	380,458	1,001	1,521	2,522	2.6	4.0	6.6	3,712	32.8
Yokosuka	333,505	16	87	103	.05	.25	.3	238	
Hiratsuka	50,219	228	292	520	4.5	5.8	10.3		
Odawara	57,751	48	40	88	.8	.7	1.5	5	
Fujiwara	54,664	21	38	59	.4	.7	1.1	3	
Kamakura	43,156	1	2	3			.1	3	
Niigata:									
Niigata	177,767	73	216	289	.4	1.2	1.6	4	
Nagaoka	67,139	831	1,908	2,739	12.4	28.4	40.8	929	
Toyama:									
Toyama	160,581	2,149	3,787	5,936	13.4	23.6	37.0	1,492	65.5
Takaoka	112,825	25	16	41	.2	.1	.3		
Fukui:									
Fukui	99,506	1,584	1,556	3,140	15.9	15.6	31.5	961	84.8
Tsuruga	30,544	153	312	465	5.0	10.2	15.2	712	68.0
Yamanashi:									
Kofu	105,538	832	1,262	2,094	7.9	11.9	19.8	983	65.0

Prefecture and city	Population 1944	Casualties			Casualties per 1,000 population				Percent of built-up area destroyed
		Deaths	Injuries	Total	Deaths	Injuries	Total	Bomb tonnage	
Nagano:									
Nagano	78,118	29	27	56	.4	.3	.7	12	
Eeda	34,537	1	5	6		.2	.2	4	
Gifu:									
Gifu	175,655	818	1,059	1,877	4.7	6.0	10.7	898	74.0
Ogaki	56,997	74	152	226	1.3	2.7	4.0	664	38.0
Shizuoka:									
Hamamatsu	162,816	3,239	2,913	6,152	19.9	17.9	37.8	3,176	70.0
Shimizu	77,565	384	447	831	4.9	5.8	10.7	1,183	52.0
Numazu	90,509	268	530	798	3.0	5.8	8.8	1,067	89.5
Shizuoka	212,151	1,764	6,785	8,549	8.3	32.0	40.3	1,277	66.0
Aichi:									
Nagoya	1,349,225	8,240	17,701	25,941	6.1	13.1	19.2	14,689	31.8
Ichinomiya	66,380	546	682	1,228	8.2	10.3	18.5	1,640	86.0
Okazaki	80,443	151	129	280	1.9	1.6	3.5	859	68.0
Toyohashi	141,235	576	796	1,372	4.1	5.6	9.7	1,059	52.0
Handa	60,721	134	197	331	2.2	3.2	5.4	545	
Toyokawa	74,869	1,330	992	2,322	17.8	13.2	31.0	813	
Seto	39,161		5	5		.1	.1	8	
Kasugai	43,264	12	30	42	.3	.7	1.0		
Mie:									
Tsu	75,650	1,498	919	2,417	19.8	12.1	31.9	1,549	71.1
Uji-Yamada	64,807	102	228	330	1.6	3.5	5.1	832	39.0
Yokkaichi	116,379	834	1,641	2,475	7.2	14.1	21.3	1,342	35.0
Kuwana	42,921	469	945	1,414	10.9	22.0	32.9	1,511	77.0
Matsuzaka	34,175	13	25	38	.4	.7	1.1	85	
Suzuka	59,510	32	76	108	.5	1.3	1.8		
Ueno	31,329		1	1				2	
Shiga:									
Otsu	66,662	18	125	143	.3	1.9	2.2	22	
Hikone	39,703	17	57	74	.4	1.4	1.8		
Nagahama	39,186		1	1				9	
Kyoto:									
Kyoto	965,399	81	213	296	.1	.2	.3	14	
Maizuru	120,975	7	6	13			.1	48	
Osaka:									
Osaka	2,842,954	13,973	19,791	33,764	4.9	7.0	11.9	11,217	37.0
Sakai	220,814	1,407	1,487	2,894	6.4	6.7	13.1	777	42.5
Kishiwada	77,715	18	45	63	.2	.6	.8		
Toyonaka	43,985	575	898	1,473	13.1	20.4	33.5		
Ikeda	36,073	14	18	32	.4	.5	.9	8	
Suita	63,928	57	99	156	.9	1.5	2.4		
Fuse	132,537	40	53	93	.3	.4	.7		
Takatsuki	30,584	3	10	13	.1	.3	.4	6	
Izumi Otsu	26,641		3	3		.1	.1		
Hyogo:									
Kobe	919,141	7,051	4,061	11,112	7.7	4.4	12.1	6,174	56.0
Amagasaki	270,073	573	305	878	2.1	1.1	3.2	3,629	
Akashi	78,585	1,529	495	2,024	19.5	6.3	25.8	1,617	43.5
Ashiya	37,761	703	376	1,079	18.6	10.0	28.6	6	
Nishinomiya	127,457	749	442	1,191	5.9	3.4	9.3	2,004	32.0
Himiji	103,733	541	154	695	4.9	1.5	6.4	1,130	76.7
Shikama	36,685	6	7	13	.2	.2	.4		
Itami	40,708	19	16	35	.5	.4	.9	19	
Aioi	36,069	35	43	78	1.0	1.2	2.2		
Nara:									
Nara	60,727	1	13	14		.2	.2	12	
Wakayawa:									
Wakayama	205,505	1,625	4,675	6,300	7.9	22.8	30.7	928	52.5
Kainau	27,161	36	54	90	1.3	2.0	3.3		
Tanabe	30,783	20	120	140	.6	.6	1.2	54	
Shingu	29,717	74	103	177	2.5	3.5	6.0	176	
Tottori:									
Yonago	47,030	5	9	14	.1	.2	.3	11	
Shimane:									
Hamoda	31,492								
Okayama:									
Okayama	162,000	1,745	975	2,720	10.8	6.0	16.8	989	63.0
Tamano	45,131	13	47	60	.3	1.0	1.3	7	
Hiroshima:									
Hiroshima	343,034	42,561	57,530	100,091	124.1	167.7	291.8	33	
Kure	339,278	1,967	702	2,669	5.8	2.1	7.9	3,820	46.0
Fukugama	57,490	275	393	668	4.8	6.8	11.6	556	73.3
Onamichi	48,864		2	2					

Prefecture and city	Population 1944	Casualties			Casualties per 1,000 population				Percent of built-up area destroyed
		Deaths	Injuries	Total	Deaths	Injuries	Total	Bomb tonnage	
Yamaguchi:									
Shimoneseki	207,142	241	505	746	1.2	2.4	3.6	839	36.0
Ube	124,309	336	591	927	2.7	4.8	7.5	2,317	23.0
Tokuyama	83,671	942	668	1,610	11.2	8.0	19.2	1,325	53.0
Iwakumi	55,177	813	329	1,142	14.7	6.0	20.7	181	----------
Kudamatsu	38,164	146	105	251	3.8	2.8	6.6	703	----------
Hikari	50,441	52	62	114	1.0	1.2	2.2	885	----------
Onoda	51,276	8	21	29	.2	.4	.6	----------	----------
Bofu	59,776	11	41	52	.2	.7	.9	7	----------
Yamaguchi	65,833	3	3	6	----------	----------	.1	----------	----------
Tokushima:									
Tokusaima	117,218	1,070	832	1,902	9.1	7.1	16.2	1,140	74.0
Kagawa:									
Takamatsu	107,237	1,273	880	2,153	11.9	8.2	20.1	833	78.0
Ehime:									
Matsuyama	137,102	380	761	1,141	2.8	5.5	8.3	1.239	73.0
Uwashima	51,320	248	279	527	4.8	5.5	10.3	1,113	52.0
Imabari	54,350	242	407	649	4.4	7.5	11.9	653	76.0
Niihama	51,505	13	91	104	.2	1.8	2.0	24	----------
Saijo	35,273	----------	7	7	----------	.2	.2	----------	----------
Yawatshama	30,680	4	2	6	.1	.1	.2	----------	----------
Kochi:									
Kochi	137,103	447	429	876	3.3	3.1	6.4	1,182	48.0
Fukuoka:									
Fukuoka	325,925	953	1,079	2,032	2.9	3.3	6.2	1,526	21.5
Moji	135,491	161	260	421	1.2	1.9	3.1	628	26.9
Kokura	192,368	137	64	201	.7	.3	1.0	----------	----------
Yawata	266,415	1,996	956	2,952	7.5	3.6	11.1	1,507	21.0
Tobata	82,731	72	78	150	.9	.9	1.8	2	----------
Wakamatsu	89,781	19	52	71	.2	.6	.8	----------	----------
Kurame	92,565	120	----------	120	1.3	----------	1.3	186	----------
Omuda	179,574	780	1,571	2,351	4.3	8.8	13.1	1,803	40.0
Saga:									
Saga	49,479	25	26	51	.5	.5	1.0	469	----------
Nagasaki:									
Nagasaki	272,312	13,294	29,739	43,033	48.8	109.2	158.0	395	----------
Sasebo	265,218	1,000	497	1,497	3.8	1.9	5.7	1,178	17.9
Omura	65,891	96	99	195	1.5	1.5	3.0	1,093	----------
Isahaya	42,643	2	5	7	----------	.1	.2	6	----------
Shimabara	29,785	8	16	24	.3	.5	.8	----------	----------
Kumamoto:									
Kumamoto	211,691	583	1,310	1,893	2.7	6.2	8.9	1,623	21.0
Arao	44,560	65	151	216	1.5	3.4	4.9	----------	----------
Yatsushiro	38,649	52	49	101	1.3	1.3	2.6	49	----------
Hitoyoshi	32,772	----------	1	1	----------	----------	----------	2	----------
Oita:									
Oita	81,787	177	270	447	2.0	3.1	5.1	1,638	25.2
Peppu	67,279	3	9	12	----------	.1	.2	14	----------
Saeki	[1] 22,204	54	30	84	2.4	1.4	3.8	386	----------
Nakatsu	41,104	1	2	3	----------	----------	.1	----------	----------
Hida	15,985	2	2	4	1.3	1.3	2.6	----------	----------
Miyazaki:									
Nobeoka	72,571	284	293	577	3.9	4.1	8.0	1,024	----------
Miyakonojo	59,575	69	105	174	1.2	1.7	2.9	830	----------
Miyazaki	80,164	135	163	298	1.7	2.0	3.7	1,366	----------
Kagoshima:									
Kagoshima	190,925	----------	----------	----------	----------	----------	----------	1,024	----------
Kanoya	52,146	----------	----------	----------	----------	----------	----------	2,249	----------
Sendai	33,855	----------	----------	----------	----------	----------	----------	----------	----------
Total	28,907,437	235,616	265,556	501,172					

[1] 1940 population.

APPENDIX C–2.—*Differences of casualty totals and populations reported for six cities by Japanese Ministry of Home Affairs and Prefectural divisions of health*

(SECTION I)

City	Ministry of Home Affairs			Prefectural health divisions			Differences		
	Deaths	Injuries	Total	Deaths	Injuries	Total	Deaths	Injuries	Total
Tokyo	93,056	59,633	152,689	93,329	141,083	234,412	+273	+81,450	+81,723
Osaka	13,973	19,791	33,764	10,966	23,245	34,211	—3,007	+3,454	447
Yokohama	4,616	14,215	18,831	4,616	14,215	18,831	0	0	0
Kobe	7,051	4,061	11,112	9,209	20,702	29,911	+2,158	+16,641	+18,799
Nagoya	8,240	17,701	25,941	8,240	10,519	18,759	0	—7,182	—7,182
Sendai	992	1,687	2,679	1,167	1,909	3,076	+175	+222	+397
Total	127,928	117,088	245,016	127,527	211,673	339,200	—401	+94,585	+94,184

Population

City	1944 census	Bombing period	Differences
Tokyo	6,577,620	5,469,214	—1,108,406
Osaka	2,842,954	1,726,085	—1,116,869
Yokohama	1,034,740	780,721	—254,019
Kobe	919,141	631,567	—287,574
Nagoya	1,349,225	1,131,423	—217,802
Sendai	264,277	277,496	+13,219
Total	12,987,957	10,016,506	—2,971,451

(SECTION II)

City	Ministry of Home Affairs			Survey Parties			Differences (— = decrease)		
	Deaths	Injuries	Total	Deaths	Injuries	Total	Deaths	Injuries	Total
Hiroshima	42,561	57,530	100,091	80,000	100,000	180,000	+37,439	+42,470	+79,909
Nagasaki	13,294	29,739	43,033	40,000	60,000	100,000	+26,706	+30,261	+56,967
Total	55,855	87,269	143,124	120,000	160,000	280,000	+64,145	+72,731	+136,876

Population

City	1944 census	Survey parties	Difference
Hiroshima	343,034	310,000	—33,034
Nagasaki	272,312	225,000	—47,312
Total	615,346	535,000	—80,346

APPENDIX D–1.—*Hospital admissions to 27 Japanese hospitals, 1943–45*

City and hospital	1944			1945									
	October	November	December	January	February	March	April	May	June	July	August	September	October	November
Kobe														
Kawasaki Hospital	.....	.....	151	262	156	234	101	96	123	105	107	28	55	.....
Kyoto Prefectural Medical College	.....	.....	170	185	133	179	149	97	187	159	165	157	153	.....
Kobe Hospital, Japanese Seamen's Aid Society	.....	.....	.....	.....	49	35	27	25	12	34	27	28	17	.....
Total (1944–45)	.....	.....	321	447	338	448	277	218	322	298	299	213	225	.....
	1944			1945										
Kyoto														
Kyoto Municipal Transportation Hospital	13	5	4	4	6	9	15	13	16	16	9	14	.....	.....
Fushimi Branch of Kyoto Prefectural Hospital	67	53	60	65	68	105	73	78	74	62	82	79	.....	.....
Kyoto Prefectural Hospital	562	520	501	539	476	611	577	650	413	561	565	490	.....	.....
Kyoto University Medical College	335	276	229	187	195	306	281	307	253	336	232	278	.....	.....
Total (1944–45)	977	854	794	795	745	1,031	946	1,048	756	975	888	861	.....	.....
	1943			1944										
Kyoto Municipal Transportation Hospital	27	13	9	9	10	14	3	17	11	13	18	14	.....	.....
	1944			1945										
Nagoya														
Nagoya Imperial University Hospital (Tashincho Branch)	.....	.....	61	62	59	127	51	82	125	82	59	48	77	.....
Nagoya Women's Medical College Hospital	.....	.....	211	104	117	349	179	271	327	108	88	104	121	.....
Total (1944–45)	.....	.....	272	166	176	476	230	353	452	190	147	152	198	.....
	1943			1944										
Nagoya Women's Medical College Hospital	.....	.....	263	245	255	341	343	369	361	364	275	263	263	186
	1944			1945										
Osaka														
Osaka Imperial University Hospital	598	470	370	371	316	380	375	357	709	246	281	390	.....	.....
Clinic Building of the Osaka Girls Medical College	109	124	95	139	101	142	168	111	185	108	114	108	.....	.....
Osaka Police Hospital	160	142	112	104	94	127	106	131	51	65	95	107	.....	.....
Osaka Kaisei Hospital	95	71	63	103	62	57	37	28	81	11	31	33	.....	.....
Osaka Higher Medical Technical School Hospital	233	193	175	180	212	239	235	261	247	282	328	263	.....	.....
Hospital of Osaka Municipal Transport Bureau	73	26	20	18	28	13	11	26	8	11	17	13	.....	.....
Total (1944–45)	1,268	1,026	835	915	813	958	932	914	1,281	723	866	914	.....	.....
	1943			1944										
Osaka Imperial University Hospital	565	541	543	580	472	525	537	692	665	664	519	582	.....	.....
							1945							
Sendai														
Tohoku Imperial University Hospital	.....	.....	.....	.....	.....	.....	453	459	320	484	356	370	.....	.....
Sendai Communications Hospital	.....	.....	.....	.....	.....	.....	38	31	32	48	14	20	.....	.....
Tokoyanogi Hospital	.....	.....	.....	.....	.....	.....	15	18	20	16	16	32	.....	.....
Ina Washiro Hospital	.....	.....	.....	.....	.....	.....	24	31	15	.....	.....	31	.....	.....
Total (1945)	.....	.....	.....	.....	.....	.....	530	539	387	548	386	453	.....	.....
							1944							
Tohoku Imperial University Hospital	.....	.....	.....	.....	.....	.....	475	441	445	475	434	419	.....	.....
			1944	1945										
Tokyo														
Tokyo Imperial University Hospital	.....	.....	322	274	241	563	315	396	254	266	274	280	394	.....
Okubo Hospital	.....	.....	54	61	56	223	83	133	66	49	45	33	56	.....
The "Hiro" Metropolitan Hospital	.....	.....	61	60	52	121	55	144	44	68	32	55	37	.....
Shitoya Hospital of the Japan Medical Treatment Corporation	.....	.....	98	125	108	216	151	79	87	93	112	117	91	.....
Showa Medical College Hospital	.....	.....	139	124	118	217	205	392	142	149	160	163	144	.....
Tokyo Jikiikai Medical College Hospital	.....	.....	149	159	131	263	168	198	117	92	95	90	124	.....
Total (1944–45)	.....	.....	823	803	706	1,603	977	1,342	710	717	718	738	846	.....

APPENDIX D–1 (*continued*)

City and hospital	1944			1945									
	October	November	December	January	February	March	April	May	June	July	August	September	October	November
			1943	1944										
The "Hiro" Metropolitan Hospital			103	108	101	98	110	127	123	108	94	93		
			1944	1945										
Yokohama														
The Juzen Hospital of Yokohama city			99	166	149	180	266	476	115	129	144	218	164	
The Koiyu Hospital			31	40	32	40	65	78	130	30	6			
Total (1944–45)			130	206	181	220	331	554	245	159	150	218	164	

APPENDIX E–1

A course for the training of public health officers under the auspices of the Government Institute for Infectious Diseases:

1. The chief purpose of the course is the reeducation of the public health officers to meet the emergency.
2. Curricula:
   a. Recent advances in the clinical aspects of veneral diseases.
   b. Recent advances in the bacteriology and serology of venereal diseases.
   c. Administrative control of the venereal diseases at this juncture.
   d. Laboratory exercises.

Hours of study

Subject of study	Administrative and clinical	Bacteriological	Practice
General	3		
Syphilis	3	6.0	3
Gonorrhea	3	3.0	9
Chancroid	1.5	1.5	
Lymphogr. inguinale	1.5	1.5	

APPENDIX E–2

Proposed examination for Neisseria gonorrhea :

1. Clinical examination.
2. Microscopic examination:
   a. Specimens are collected from urethra, portio uteri, and Bartholin's gland.
   b. Fix slide preparations by heat.
   c. Stain by Gram's method.
   d. Results:
      (+) intracellular Gram-negative diplococci.
      (±) extracellular Gram-negative diplococci.
      (—) no suspicious organism.
3. Cultural examination:
   a. Cultural examinations are made if—
      (1) clinically..... (+), and

APPENDIX E–2 (*continued*)

      microscopically..... (—), or (+)
      (2) clinically..... (—), and
      microscopically..... (+)
   b. Collection of specimens should be made anew.
   c. Media:
      Chocolate agar plate, pH 7.4–7.6.
      For the preparation of media—"Saikingaku-Zissyu-Teiyo" (Manual of Laboratory Technique in Bacteriology, 1941), page 65.
   d. Inoculation of media:
      "Saikingaku-Zissyu-Teiyo", page 84 *et. seq.*
   e. Incubate for 48 hours at 37°C. (Preferably in the presence of about 10 percent carbon dioxide).
   f. Examination of colonies:
      (1) The oxidase reaction (if available).
      Flow over the plate a one percent aqueous solution of p-amino-dimethyl-aniline monohydrochloride. Within a few minutes, colonies of gonococci become pink, changing to maroon and finally black.
      (2) Microscopical examinations are made with smears taken from suspicious (small, gray, finely granular) colonies.
      (3) Fermentation tests (dextrose, maltose and sucrose) can be omitted.
4. Differential diagnosis of gonorrhoea:

Clinical	Microscopical	Cultural	Diagnosis
+	+	Omitted	+
	+	+	+
	—	—	Retest [1]
—	+	Omitted	+
	±	+	+
		—	—
	—	Depends upon anamonesis [2]	—

[1] If gonococci are not found on the re-examination, the case is recorded as negative. Information concerning clinical history of the patient, method of treatment received, etc., should also be given in the report.

[2] In case the patient has history of previous infection culture should be done.

REFERENCES

1. Medical and Sanitary Data on Japan. War Department Technical Bulletin, T. B. Med. 160. May 1945.
2. Manual on Methods of Testing Water, Japanese Water-Works, Association, October 1944.
3. Explanatory Notes on Methods of Testing Service Water, Aizawa Kingo, Japanese Water-works Association.
4. Report on the Installations of the Tokyo water works. Headquarters, U. S. Army Service Command C. November 1945. (Unpublished)
5. Explanation on the Tokyo Water-works for USSBS, E. Iwasaki. (Unpublished)
6. Report on Yokohama Water Supply. U. S. Army Service Command C, October 1945. (Unpublished)
7. Outline of the Osaka Municipal Water System. November 1934.
8. 16th Annual Report. Tokyo Hygienic Laboratory. Ministry of Health and Welfare. 1939.
9. Report of Scavenger Department, to Medical Division. USSBS, Tokyo October 1945. (Unpublished)
10. Annual Health Report of the Ministry of Health and Social Affairs for the 13th Year of Showa. (1938), 1940.
11. Bacteriological and Parasitological Study of the Night Soil Disposal in Japan. Dr. Tokuro Takano, M.D. Journal of the Public Health Association of Japan. Vol. III. No. 12, December 1927.
12. Report on the Sewerage System of Tokyo. Headquarters U. S. Army Service Command C, 13 November 1945. (Unpublished)
13. Civil Affairs Handbook, Japan, Section 1A: Population Statistics, Headquarters, Army Service Forces, March 1945.
14. The sewerage works of Tokyo, Section of Sewerage, Tokyo Metropolitan Office to the Medical Division, USSBS, Oct. 1945. (Unpublished)
15. Report of Sewerage department, City of Osaka, to Medical Division, USSBS, November 1945. (Unpublished)
16. Report of Section of Sewerage, City of Tokyo, to Medical Division, USSBS, November 1945.
17. Report of the Department of Water and Water Disposal, City of Yokohama, to Medical Division, USSBS. November 1945. (Unpublished)
18. Tokyo Shisei Chosa Kai: Nippon Toshi Nenkan 1941 (Japan Municipal Year Book for 1941) Tokyo 1940.
19. Report of Cleaning Department, City of Osaka, to Medical Division USSBS, November 1945 (Unpublished)
20. Report of Cleaning Department, City of Kyoto, to Medical Division, USSBS. November 1945. (Unpublished)
21. Laws and Regulations of Sanitation. Tokyo Ministry of Public Welfare.
22. Mitsubishi Economic Research Bureau, Tokyo, *Japanese Trade and Industry, Present and Future*, London, 1936.
23. War Department Technical Bulletin, TB Med 160, *Medical and Sanitary Data on Japan*, Washington, D. C., 1945.
24. Medicine Control Company, Ltd.
    (a) *List of Annual Plan for Allotment of Production Concerning 43 Articles of Essential Medicine for Army, Navy and Civilian Demands in Four Respective Years between 1942–45*, November 1945.
    (b) *Actual Annual Production of 43 Articles of Essential Medicine between 1936–1944*, November 1945.
    (c) *Quarterly Production of 43 Articles of Essential Medicine for Four Respective Years between 1941–1944*, November 1945.
25. Medicine Control Company, Ltd., *Production of Various Sulfa Drugs in 1943–44–45.*
26. Dr. Shozainon Keimatsu, *Production of Medical Supplies in Japan (in Yen value)*, November 1945.
27. Ministry of Public Health and Welfare, *Statistics on Destroyed Factories*, March 1946.
28. Osaka Prefecture Office, Pharmaceutical Division, *Table of Bomb Damage to Pharmaceutical Factories.*

UNITED STATES STRATEGIC BOMBING SURVEY

LIST OF REPORTS

The following is a bibliography of reports resulting from the Survey's studies on the European and Pacific wars. Those reports marked with an asterisk (*) may be purchased from the Superintendent of Documents at the Government Printing Office, Washington, D. C.

European War

OFFICE OF THE CHAIRMAN

*1 The United States Strategic Bombing Survey: Summary Report (European War)
*2 The United States Strategic Bombing Survey: Over-all Report (European War)
*3 The Effects of Strategic Bombing on the German War Economy

AIRCRAFT DIVISION

(By Division and Branch)

*4 Aircraft Division Industry Report
5 Inspection Visits to Various Targets (Special Report)

Airframes Branch

6 Junkers Aircraft and Aero Engine Works, Dessau, Germany
7 Erla Maschinenwerke G m b H, Heiterblick, German
8 A T G Maschinenbau, G m b H, Leipzig (Mockau), Germany
9 Gothaer Waggonfabrik, A G, Gotha, Germany
10 Focke Wulf Aircraft Plant, Bremen, Germany
11 Messerschmitt A G, Augsburg, Germany — Over-all Report; Part A; Part B; Appendices I, II, III
12 Dornier Works, Friedrichshafen & Munich, Germany
13 Gerhard Fieseler Werke G m b H, Kassel, Germany
14 Wiener Neustaedter Flugzeugwerke, Wiener Neustadt, Austria

Aero Engines Branch

15 Bussing NAG Flugmotorenwerke G m b H, Brunswick, Germany
16 Mittel-Deutsche Motorenwerke G m b H, Taucha, Germany
17 Bavarian Motor Works Inc, Eisenach & Durrerhof, Germany
18 Bayerische Motorenwerke A G (BMW) Munich, Germany
19 Henschel Flugmotorenwerke, Kassel, Germany

Light Metal Branch

20 Light Metals Industry of Germany — Part I, Aluminum; Part II, Magnesium
21 Vereinigte Deutsche Metallwerke, Hildesheim, Germany
22 Metallgussgesellschaft G m b H, Leipzig, Germany
23 Aluminiumwerk G m b H, Plant No. 2, Bitterfeld, Germany
24 Gebrueder Giulini G m b H, Ludwigshafen, Germany
25 Luftschiffbau, Zeppelin G m b H, Friedrichshafen on Bodensee, Germany
26 Wieland Werke A G, Ulm, Germany
27 Rudolph Rautenbach Leichmetallgiessereien, Solingen, Germany
28 Lippewerke Vereinigte Aluminiumwerke A G, Lunen, Germany
29 Vereinigte Deutsche Metallwerke, Heddernheim, Germany
30 Duerener Metallwerke A G, Duren Wittenau-Berlin & Waren, Germany

AREA STUDIES DIVISION

*31 Area Studies Division Report
32 A Detailed Study of the Effects of Area Bombing on Hamburg
33 A Detailed Study of the Effects of Area Bombing on Wuppertal
34 A Detailed Study of the Effects of Area Bombing on Dusseldorf
35 A Detailed Study of the Effects of Area Bombing on Solingen
36 A Detailed Study of the Effects of Area Bombing on Remscheid
37 A Detailed Study of the Effects of Area Bombing on Darmstadt
38 A Detailed Study of the Effects of Area Bombing on Lubeck
39 A Brief Study of the Effects of Area Bombing on Berlin, Augsburg, Bochum, Leipzig, Hagen, Dortmund, Oberhausen, Schweinfurt, and Bremen

CIVILIAN DEFENSE DIVISION

*40 Civilian Defense Division—Final Report
41 Cologne Field Report
42 Bonn Field Report
43 Hanover Field Report
44 Hamburg Field Report—Vol I, Text; Vol II, Exhibits
45 Bad Oldesloe Field Report
46 Augsburg Field Report
47 Reception Areas in Bavaria, Germany

EQUIPMENT DIVISION

Electrical Branch

*48 German Electrical Equipment Industry Report
49 Brown Boveri et Cie, Mannheim Kafertal, Germany

Optical and Precision Instrument Branch

*50 Optical and Precision Instrument Industry Report

Abrasives Branch

*51 The German Abrasive Industry
52 Mayer and Schmidt, Offenbach on Main, Germany

Anti-Friction Branch

*53 The German Anti-Friction Bearings Industry

Machine Tools Branch

*54 Machine Tools & Machinery as Capital Equipment
*55 Machine Tool Industry in Germany
56 Herman Kolb Co., Cologne, Germany
57 Collet and Engelhard, Offenbach, Germany
58 Naxos Union, Frankfort on Main, Germany

MILITARY ANALYSIS DIVISION

59 The Defeat of the German Air Force

60 V-Weapons (Crossbow) Campaign
61 Air Force Rate of Operation
62 Weather Factors in Combat Bombardment Operations in the European Theatre
63 Bombing Accuracy, USAAF Heavy and Medium Bombers in the ETO
64 Description of RAF Bombing
64a The Impact of the Allied Air Effort on German Logistics

MORALE DIVISION

*64b The Effects of Strategic Bombing on German Morale
(Vol I and Vol II)

Medical Branch

*65 The Effect of Bombing on Health and Medical Care in Germany

MUNITIONS DIVISION

Heavy Industry Branch

*66 The Coking Industry Report on Germany
67 Coking Plant Report No. 1, Sections A, B, C, & D
68 Gutehoffnungshuette, Oberhausen, Germany
69 Friedrich-Alfred Huette, Rheinhausen, Germany
70 Neunkirchen Eisenwerke A G, Neunkirchen, Germany
71 Reichswerke Hermann Goering A G, Hallendorf Germany
72 August Thyssen Huette A G, Hamborn, Germany
73 Friedrich Krupp A G, Borbeck Plant, Essen, Germany
74 Dortmund Hoerder Huettenverein, A G, Dortmund, Germany
75 Hoesch A G, Dortmund, Germany
76 Bochumer Verein fuer Gusstahlfabrikation A G, Bochum, Germany

Motor Vehicles and Tanks Branch

*77 German Motor Vehicles Industry Report
*78 Tank Industry Report
79 Daimler Benz A G, Unterturkheim, Germany
80 Renault Motor Vehicles Plant, Billancourt, Paris
81 Adam Opel, Russelheim, Germany
82 Daimler Benz-Gaggenau Works, Gaggenau, Germany
83 Maschinenfabrik Augsburg-Nurnberg, Nurnberg, Germany
84 Auto Union A G, Chemnitz and Zwickau, Germany
85 Henschel & Sohn, Kassel, Germany
86 Maybach Motor Works, Friedrichshafen, Germany
87 Voigtlander, Maschinenfabrik A G, Plauen, Germany
88 Volkswagenwerke, Fallersleben, Germany
89 Bussing NAG, Brunswick, Germany
90 Muehlenbau Industrie A G (Miag) Brunswick, Germany
91 Friedrich Krupp Grusonwerke, Magdeburg, Germany

Submarine Branch

92 German Submarine Industry Report
93 Maschinenfabrik Augsburg-Nurnberg A G, Augsburg, Germany
94 Blohm and Voss Shipyards, Hamburg, Germany
95 Deutschewerke A. G, Kiel, Germany
96 Deutsche Schiff und Maschinenbau, Bremen, Germany
97 Friedrich Krupp Germaniawerft, Kiel, Germany
98 Howaldtswerke A. G, Hamburg, Germany
99 Submarine Assembly Shelter, Farge, Germany
100 Bremer Vulkan, Vegesack, Germany

Ordnance Branch

*101 Ordnance Industry Report
102 Friedrich Krupp Grusonwerke A. G Magdeburg Germany
103 Bochumer Verein fuer Gusstahlfabrikation A G, Bochum, Germany
104 Henschel & Sohn, Kassel, Germany
105 Rheinmetall-Borsig, Dusseldorf, Germany
106 Hermann Goering Werke, Braunschweig, Hallendorf, Germany
107 Hannoverische Maschinenbau, Hanover, Germany
108 Gusstahlfabrik Friedrich Krupp, Essen, Germany

OIL DIVISION

*109 Oil Division, Final Report
*110 Oil Division, Final Report, Appendix
*111 Powder, Explosives, Special Rockets and Jet Propellants, War Gases and Smoke Acid (Ministerial Report #1)
112 Underground and Dispersal Plants in Greater Germany
113 The German Oil Industry, Ministerial Report Team 78
114 Ministerial Report on Chemicals

Oil Branch

115 Ammoniakwerke Merseburg G m b H, Leuna, Germany—2 Appendices
116 Braunkhole Benzin A G, Zeitz and Bohlen, Germany Wintershall A G, Leutzkendorf, Germany
117 Ludwigshafen-Oppau Works of I G Farbenindustrie A G, Ludwigshafen, Germany
118 Ruhroel Hydrogenation Plant, Bottrop-Boy, Germany, Vol. 1, Vol. 11.
119 Rhenania Ossag Mineraloelwerke A G, Harburg Refinery, Hamburg, Germany
120 Rhenania Ossag Mineraloelwerke A G, Grasbrook Refinery, Hamburg, Germany
121 Rhenania Ossag Mineraloelwerke A G, Wilhelmsburg Refinery, Hamburg, Germany
122 Gewerkschaft Victor, Castrop-Rauxel, Germany, Vol. I & Vol. II
123 Europaeische Tanklager und Transport A G, Hamburg, Germany
124 Ebano Asphalt Werke A G, Harburg Refinery, Hamburg, Germany
125 Meerbeck Rheinpreussen Synthetic Oil Plant—Vol. I & Vol. II

Rubber Branch

126 Deutsche Dunlop Gummi Co., Hanau on Main, Germany
127 Continental Gummiwerke, Hanover, Germany
128 Huels Synthetic Rubber Plant
129 Ministerial Report on German Rubber Industry

Propellants Branch

130 Elektrochemischewerke, Munich, Germany
131 Schoenebeck Explosive Plant, Lignose Sprengstoff Werke G m b H, Bad Salzemen, Germany
132 Plants of Dynamit A G, Vormal, Alfred Nobel & Co, Troisdorf, Clausthal, Drummel and Duneberg, Germany
133 Deutsche Sprengchemie G m b H, Kraiburg, Germany

OVER-ALL ECONOMIC EFFECTS DIVISION

134 Over-all Economic Effects Division Report
Gross National Product.....
Kriegseilberichte .....
Herman Goering Works.....
Food and Agriculture.....
} Special papers which together comprise the above report
134a Industrial Sales Output and Productivity

PHYSICAL DAMAGE DIVISION

134b Physical Damage Division Report (ETO)
135 Villacoublay Airdrome, Paris, France
136 Railroad Repair Yards, Malines, Belgium
137 Railroad Repair Yards, Louvain, Belgium
138 Railroad Repair Yards, Hasselt, Belgium
139 Railroad Repair Yards, Namur, Belgium
140 Submarine Pens, Brest, France
141 Powder Plant, Angouleme, France
142 Powder Plant, Bergerac, France
143 Coking Plants, Montigny & Liege, Belgium
144 Fort St. Blaise Verdun Group, Metz, France
145 Gnome et Rhone, Limoges, France
146 Michelin Tire Factory, Clermont-Ferrand, France
147 Gnome et Rhone Aero Engine Factory, Le Mans, France
148 Kugelfischer Bearing Ball Plant, Ebelsbach, Germany
149 Louis Breguet Aircraft Plant, Toulouse, France
150 S. N. C. A. S. E. Aircraft Plant, Toulouse, France
151 A. I. A. Aircraft Plant, Toulouse, France
152 V Weapons in London
153 City Area of Krefeld
154 Public Air Raid Shelters in Germany
155 Goldenberg Thermal Electric Power Station, Knapsack, Germany
156 Brauweiler Transformer & Switching Station, Brauweiler, Germany
157 Storage Depot, Nahbollenbach, Germany
158 Railway and Road Bridge, Bad Munster, Germany
159 Railway Bridge, Eller, Germany
160 Gustloff-Werke Weimar, Weimar, Germany
161 Henschell & Sohn G m b H, Kassel, Germany
162 Area Survey at Pirmasens, Germany
163 Hanomag, Hanover, Germany
164 M A N Werke Augsburg, Augsburg, Germany
165 Friedrich Krupp A G, Essen, Germany
166 Erla Maschinenwerke G m b H, Heiterblick, Germany
167 A T G Maschinenbau G m b H, Mockau, Germany
168 Erla Maschinenwerke G m b H, Mockau, Germany
169 Bayerische Motorenwerke, Durrerhof, Germany
170 Mittel-Deutsche Motorenwerke G m b H, Taucha, Germany
171 Submarine Pens Deutsche-Werft, Hamburg, Germany
172 Multi-Storied Structures, Hamburg, Germany
173 Continental Gummiwerke, Hanover, Germany
174 Kassel Marshalling Yards, Kassel, Germany
175 Ammoniawerke, Merseburg-Leuna, Germany
176 Brown Boveri et Cie, Mannheim, Kafertal, Germany
177 Adam Opel A G, Russelsheim, Germany
178 Daimler-Benz A G, Unterturkheim, Germany
179 Valentin Submarine Assembly, Farge, Germany
180 Volkswaggonwerke, Fallersleben, Germany
181 Railway Viaduct at Bielefeld, Germany
182 Ship Yards Howaldtswerke, Hamburg, Germany
183 Blohm and Voss Shipyards, Hamburg, Germany
184 Daimler-Benz A G, Mannheim, Germany
185 Synthetic Oil Plant, Meerbeck-Hamburg, Germany
186 Gewerkschaft Victor, Castrop-Rauxel, Germany
187 Klockner Humboldt Deutz, Ulm, Germany
188 Ruhroel Hydrogenation Plant, Bottrop-Boy, Germany
189 Neukirchen Eisenwerke A G, Neukirchen, Germany
190 Railway Viaduct at Altenbecken, Germany
191 Railway Viaduct at Arnsburg, Germany
192 Deurag-Nerag Refineries, Misburg, Germany
193 Fire Raids on German Cities
194 I G Farbenindustrie, Ludwigshafen, Germany, Vol I & Vol II
195 Roundhouse in Marshalling Yard, Ulm, Germany
196 I G Farbenindustrie, Leverkusen, Germany
197 Chemische-Werke, Huels, Germany
198 Gremberg Marshalling Yard, Gremberg, Germany
199 Locomotive Shops and Bridges at Hamm, Germany

TRANSPORTATION DIVISION

*200 The Effects of Strategic Bombing on German Transportation
201 Rail Operations Over the Brenner Pass
202 Effects of Bombing on Railroad Installations in Regensburg, Nurnberg and Munich Divisions
203 German Locomotive Industry During the War
204 German Military Railroad Traffic

UTILITIES DIVISION

*205 German Electric Utilities Industry Report
206 1 to 10 in Vol I "Utilities Division Plant Reports"
207 11 to 20 in Vol II "Utilities Division Plant Reports"
208 21 Rheinische-Westfalische Elektrizitaetswerk A G

Pacific War

OFFICE OF THE CHAIRMAN

*1 Summary Report (Pacific War)
*2 Japan's Struggle to End The War
*3 The Effects of Atomic Bombs on Hiroshima and Nagasaki

CIVILIAN STUDIES

Civilian Defense Division

4 Field Report Covering Air Raid Protection and Allied Subjects, Tokyo, Japan
5 Field Report Covering Air Raid Protection and Allied Subjects, Nagasaki, Japan
*6 Field Report Covering Air Raid Protection and Allied Subjects, Kyoto, Japan
7 Field Report Covering Air Raid Protection and Allied Subjects, Kobe, Japan
8 Field Report Covering Air Raid Protection and Allied Subjects, Osaka, Japan
9 Field Report Covering Air Raid Protection and Allied Subjects, Hiroshima, Japan—No. 1
*10 Summary Report Covering Air Raid Protection and Allied Subjects in Japan
*11 Final Report Covering Air Raid Protection and Allied Subjects in Japan

Medical Division

*12 The Effects of Bombing on Health and Medical Services in Japan
*13 The Effects of Atomic Bombs on Health and Medical Services in Hiroshima and Nagasaki

Morale Division

*14 The Effects of Strategic Bombing on Japanese Morale

ECONOMIC STUDIES

Aircraft Division

*15 The Japanese Aircraft Industry
*16 Mitsubishi Heavy Industries, Ltd.
Corporation Report No. I
(Mitsubishi Jukogyo KK)
(Airframes & Engines)
*17 Nakajima Aircraft Company, Ltd.
Corporation Report No. II
(Nakajima Hikoki KK)
(Airframes & Engines)
*18 Kawanishi Aircraft Company
Corporation Report No. III
(Kawanishi Kokuki Kabushiki Kaisha)
(Airframes)

*19 Kawasaki Aircraft Industries Company, Inc.
Corporation Report No. IV
(Kawasaki Kokuki Kogyo Kabushiki Kaisha)
(Airframes & Engines)

*20 Aichi Aircraft Company
Corporation Report No. V
(Aichi Kokuki KK)
(Airframes & Engines)

*21 Sumitomo Metal Industries, Propeller Division
Corporation Report No. VI
(Sumitomo Kinzoku Kogyo KK, Puropera Seizosho)
(Propellers)

*22 Hitachi Aircraft Company
Corporation Report No. VII
(Hitachi Kokuki KK)
(Airframes & Engines)

*23 Japan International Air Industries, Ltd.
Corporation Report No. VIII
(Nippon Kokusai Koku Kogyo KK)
(Airframes)

*24 Japan Musical Instrument Manufacturing Company
Corporation Report No. IX
(Nippon Gakki Seizo KK)
(Propellers)

*25 Tachikawa Aircraft Company
Corporation Report No. X
(Tachikawa Hikoki KK)
(Airframes)

*26 Fuji Airplane Company
Corporation Report No. XI
(Fuji Hikoki KK)
(Airframes)

*27 Showa Airplane Company
Corporation Report No. XII
(Showa Hikoki Kogyo KK)
(Airframes)

*28 Ishikawajima Aircraft Industries Company, Ltd.
Corporation Report No. XIII
Ishikawajima Koku Kogyo Kabushiki Kaisha)
(Engines)

*29 Nippon Airplane Company
Corporation Report No. XIV
(Nippon Hikoki KK)
(Airframes)

*30 Kyushu Airplane Company
Corporation Report No. XV
(Kyushu Hikoki KK)
(Airframes)

*31 Shoda Engineering Company
Corporation Report No. XVI
(Shoda Seisakujo)
(Components)

*32 Mitaka Aircraft Industries
Corporation Report No. XVII
(Mitaka Koku Kogyo Kabushiki Kaisha)
(Components)

*33 Nissan Automobile Company
Corporation Report No. XVIII
(Nissan Jidosha KK)
(Engines)

*34 Army Air Arsenal & Navy Air Depots
Corporation Report No. XIX
(Airframes & Engines)

*35 Underground Production of Japanese Aircraft
Report No. XX

Basic Materials Division

*36 Coal and Metals in Japan's War Economy

Capital Goods, Equipment and Construction Division

*37 The Japanese Construction Industry
*38 Japanese Electrical Equipment
*39 The Japanese Machine Building Industry

Electric Power Division

*40 The Electric Power Industry of Japan
*41 The Electric Power Industry of Japan (Plant Reports)

Manpower, Food and Civilian Supplies Division

*42 The Japanese Wartime Standard of Living and Utilization of Manpower

Military Supplies Division

*43 Japanese War Production Industries
*44 Japanese Naval Ordnance
45 Japanese Army Ordnance
*46 Japanese Naval Shipbuilding
*47 Japanese Motor Vehicle Industry
*48 Japanese Merchant Shipbuilding

Oil and Chemical Division

49 Chemicals in Japan's War
50 Chemicals in Japan's War—Appendix
51 Oil in Japan's War
52 Oil in Japan's War—Appendix

Over-all Economic Effects Division

*53 The Effects of Strategic Bombing on Japan's War Economy (Including Appendix A: U. S. Economic Intelligence on Japan—Analysis and Comparison; Appendix B: Gross National Product on Japan and Its Components; Appendix C: Statistical Sources).

Transportation Division

*54 The War Against Japanese Transportation, 1941–1945

Urban Areas Division

*55 Effects of Air Attack on Japanese Urban Economy (Summary Report)
*56 Effects of Air Attack on Urban Complex Tokyo-Kawasaki-Yokohama
*57 Effects of Air Attack on the City of Nagoya
*58 Effects of Air Attack on Osaka-Kobe-Kyoto
59 Effects of Air Attack on the City of Nagasaki
60 Effects of Air Attack on the City of Hiroshima

MILITARY STUDIES

Military Analysis Division

61 Air Forces Allied with the United States in the War Against Japan
62 Japanese Air Power
63 Japanese Air Weapons and Tactics
64 The Effect of Air Action on Japanese Ground Army Logistics
65 Employment of Forces Under the Southwest Pacific Command
66 The Strategic Air Operations of Very Heavy Bombardment in the War Against Japan (Twentieth Air Force)
67 Air Operations in China, Burma, India—World War II
68 The Air Transport Command in the War Against Japan
69 The Thirteenth Air Force in the War Against Japan
70 The Seventh and Eleventh Air Forces in the War Against Japan
71 The Fifth Air Force in the War Against Japan

Naval Analysis Division

*72 The Interrogations of Japanese Officials (Vols. I and II)
*73 Campaigns of the Pacific War
*74 The Reduction of Wake Island
*75 The Allied Campaign Against Rabaul
76 The American Campaign Against Wotje, Maleolap, Mille, and Jaluit (Vols. I, II and III)
*77 The Reduction of Truk
78 The Offensive Mine Laying Campaign Against Japan
79 Report of Ships Bombardment Survey Party—Foreword, Introduction, Conclusions, and General Summary
80 Report of Ships Bombardment Survey Party (Enclosure A), Kamaishi Area
81 Report of Ships Bombardment Survey Party (Enclosure B), Hamamatsu Area
82 Report of Ships Bombardment Survey Party (Enclosure C), Hitachi Area
83 Report of Ships Bombardment Survey Party (Enclosure D), Hakodate Area
84 Report of Ships Bombardment Survey Party (Enclosure E), Muroran Area
85 Report of Ships Bombardment Survey Party (Enclosure F), Shimizu Area
86 Report of Ships Bombardment Survey Party (Enclosures G and H), Shionomi-Saki and Nojima-Saki Areas
87 Report of Ships Bombardment Survey Party (Enclosure I), Comments and Data on Effectiveness of Ammunition
88 Report of Ships Bombardment Survey Party (Enclosure J), Comments and Data on Accuracy of Firing
89 Reports of Ships Bombardment Survey Party (Enclosure K), Effects of Surface Bombardments on Japanese War Potential

Physical Damage Division

90 Effect of the Incendiary Bomb Attacks on Japan (a Report on Eight Cities)
91 The Effects of the Ten Thousand Pound Bomb on Japanese Targets (a Report on Nine Incidents)
92 Effects of the Atomic Bomb on Hiroshima, Japan
93 Effects of the Atomic Bomb on Nagasaki, Japan
94 Effects of the Four Thousand Pound Bomb on Japanese Targets (a Report on Five Incidents)
95 Effects of Two Thousand, One Thousand, and Five Hundred Pound Bombs on Japanese Targets (a Report on Eight Incidents)
96 A Report on Physical Damage in Japan (Summary Report)

G–2 Division

97 Japanese Military and Naval Intelligence
98 Evaluation of Photographic Intelligence in the Japanese Homeland, Part I, *Comprehensive Report*
99 Evaluation of Photographic Intelligence in the Japanese Homeland, Part II, *Airfields*
100 Evaluation of Photographic Intelligence in the Japanese Homeland, Part III, *Computed Bomb Plotting*
101 Evaluation of Photographic Intelligence in the Japanese Homeland, Part IV, *Urban Area Analysis*
102 Evaluation of Photographic Intelligence in the Japanese Homeland, Part V, *Camouflage*
103 Evaluation of Photographic Intelligence in the Japanese Homeland, Part VI, *Shipping*
104 Evaluation of Photographic Intelligence in the Japanese Homeland, Part VII, *Electronics*
105 Evaluation of Photographic Intelligence in the Japanese Homeland, Part VIII, *Beach Intelligence*
*106 Evaluation of Photographic Intelligence in the Japanese Homeland, Part IX, *Artillery*
*107 Evaluation of Photographic Intelligence in the Japanese Homeland, Part X, *Roads and Railroads*
108 Evaluation of Photographic Intelligence in the Japanese Homeland, Part XI, *Industrial Analysis*

☆ U. S. GOVERNMENT PRINTING OFFICE: 1947—741801

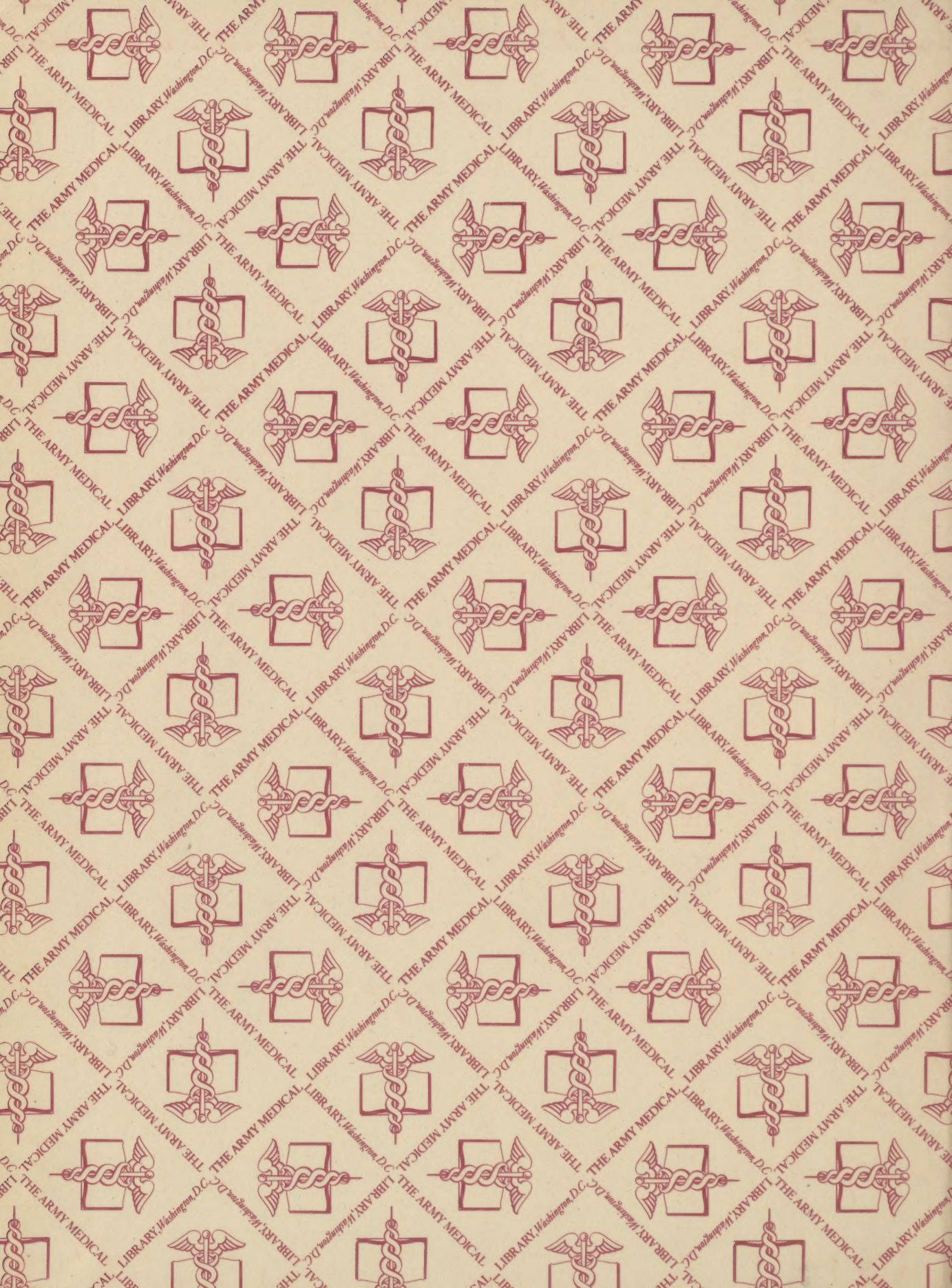
THE UNITED STATES

STRATEGIC BOMBING SURVEY

THE EFFECTS OF BOMBING ON HEALTH AND MEDICAL SERVICES IN JAPAN

Medical Division

June 1947


THE ARMY MEDICAL LIBRARY, Washington, D.C.